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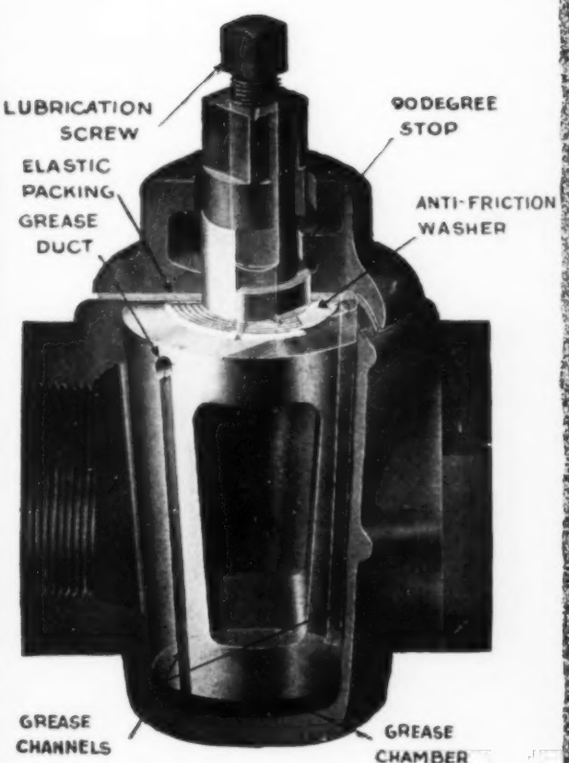
CHEMICAL & METALLURGICAL ENGINEERING



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Views on Potash: A Point of Time

IN THE pages devoted to "Readers' Views and Comments" we are glad to print a communication from FREDERICK W. BROWN, commenting on the editorial entitled "Does American Potash Need a Fixed Price?" appearing on page 220 of the issue for Sept. 1. Mr. BROWN writes as the executive secretary of an association of nearly all the American producers, and his opinions bear special weight when it is known that during the war he, as a member of the Department of Agriculture's technical staff, investigated in detail the sources of fertilizer supply and the fields of American consumption. His statement is worthy of special emphasis: "The American producers quite agree with your claims that with correct technology they will be able to compete [with foreign importations] but," he adds, "they claim, with justice, in my opinion, that they must have a brief time to install equipment which shall be technically correct, and time to reduce somewhat the excessive capital investment which now stands against the plants."

Apparently, the only important point of difference between the responsible officers of the United States Potash Producers' Association and CHEMICAL & METALLURGICAL ENGINEERING is that of *time*. They say the industry needs "a limited and temporary protection" of "two years as an irreducible minimum." On the other hand, we have stated that "the American potash industry can stand on its own feet, and can now compete with foreign importations."

It has now been nearly a year since the Armistice was signed, since war ceased. During that time many American producers have been temporarily idle, owing to inability to sell their accumulated stocks, but these have practically all been disposed of within the past few months at a price ranging close to $2.25 per unit. During that time about 8000 tons K_2O have been imported from French sources, and have been sold at from $1.50 to $1.70 per unit. Compared to the actual needs of the country—doubtless 300,000 tons K_2O—this amount of Alsatian potash is so small that its effect on the price of the meager American supply should have been small indeed. Actually, it did have a profound psychological effect, since the purchasers of potash affected to believe they would get an immense amount of cheap foreign potash immediately, and advertised this idea in order to get local potash at an unduly low price, judged by the relation of supplies to requirements.

Thus a year has passed without ruinous competition from abroad. An acute shortage of potash still exists, and famine prices should rule. As for the future, even the optimistic statement of Dr. GALE of the Geological Survey that there may be available during the next 12 months 50,000 tons of pure potash from Alsace and an equal quantity from Germany should not cause American producers to throw up their hands in despair. Germany and France are both so poor that it is inconceivable but that they will try to get as much for their exports as the market will pay. Their costs have largely increased, corresponding to the general inflation of prices the world over, and even with the maximum production from American sources, there will still be available less than two-thirds the amount which could economically be used in America. All of these facts point to a relatively high return for local potash for at least another year.

Here are the two years asked for by the best of the American plants. We are of the opinion, therefore, that potash men in the United States have been given and will still have months of breathing space in which to reorganize and stabilize their finances, and to perfect their processes. This period results from the operation of slow-moving world-wide economic conditions rather than unstable national restrictive legislation. A wise man grasps his opportunities, and makes the most of them.

The Sorry Plight of Our Educational Institutions

EMERGING from the war period and attempting to resume their pre-war activities, American colleges and universities find themselves seriously handicapped for funds with which to meet the increased cost of conducting their business. Most of them have fixed incomes, either from endowment or the State; and the problem of increasing their resources is made difficult by awaiting benefactions and bequests in the first instance, or tardy action by State legislatures in the second. In either event, expansion is retarded, salaries remain so unattractively low as to fail to hold good men on the faculties, and the authorities are confronted with the prospect of a stagnation worse than dissolution.

Harvard and the Massachusetts Institute of Technology have undertaken to raise additional endowment funds among their alumni and friends. There are other similar movements, and we welcome the opportunity to approve the general campaign for the decent support of our schools and educators. The latter are notoriously underpaid. They doubtless expect to

forego affluence and luxury, living simply and in contentment, but at the present time they are paying too high a price for their mental and spiritual advantages. The hod-carrier and the window-washer, to say nothing of that modern MIDAS, the ship-riveter, so far outstrip the poor professor in wages as to gain for him more sympathy than usual. It is not difficult to prove quite logically that teachers would all have higher salaries if their pay were commensurate with the required ability to fill their positions and the responsibility devolving upon them and their labors. They deserve better of the public; but instead of striking they merely resign and get a more remunerative, if less attractive, job. One of the most important features of the Harvard and "Tech" plans for new endowment is an increase in faculty salaries to respectable proportions. For this, if nothing more, the movement is commendable.

Welfare Work or Manpower Engineering

HERE is a dictum on "Welfare or Manpower Engineering" which was lately published in the *National Efficiency Quarterly*:

"Exit welfare work; built upon benevolence, fostered by generosity and supervised by industrial missionaries. Enter manpower engineering; established on identity of interest and charged to operating costs."

It feels good to deliver an aphorism, and we've no doubt that the author of the two above sentences has enjoyed life in augmented measure since they were first uttered. But this "exit welfare work" and "enter manpower engineering" worries us a little. If we don't look out we are likely to run amuck on the subject of engineering, and to think that it means what it does not. Engineering has to do with the science of making and using engines and machines and with such designing of works as requires special knowledge of materials, machinery and the laws of mechanics. That is substantially the definition of the Standard Dictionary, and we think it a better one than a number of all-encompassing and braggadocio definitions that have lately been going the rounds.

Manpower is exercised by the man himself, and not by his boss. We must remember that. If the man who exchanges his power for wages is to exercise judgment in the functioning of this attribute, then he becomes the engineer of his manpower, and his boss becomes the engineer of his judgment—which is stretching the concept of engineering too far. If we use the word in this sense, then the mother becomes a family engineer when she sends for the doctor to visit her sick child. And the physician becomes a nutrition engineer when he prescribes lime water to be added to the child's milk. And if we are all to get aboard the engineers' band wagon, then the writer of these lines, who is a testy old party, will put in his claim for classification as a script engineer.

Nobody likes welfare work that is designed to make him over according to the judgment of somebody else. This may be the reason why boys are ever in collusion against the schoolmaster. He wants to improve their minds by so many lines of Virgil's Æneid, and they want to quicken their faculties on the baseball diamond. Everybody wants to be free to use his judgment, whether he has any or not. It is out of this desire that all our songs of freedom are born. But we can't get away from welfare work. We may have to give it another name, because so many disagreeable and unpleasant persons have engaged in it, but no conscientious employer can dispense with it. Every decent man is engaged in welfare work among his neighbors when he tries to make the neighborhood agreeable and pleasant. This is equally true of the rich and of the poor. Welfare work is co-operative; it isn't patronage, although it must be benevolent.

We are obliged to maintain welfare work, and it should be built on benevolence. It is a mistake to think that a man must wear white whiskers and be rich and arrogant to be benevolent. Indeed he cannot be benevolent if he is arrogant. Benevolence indicates kindliness of heart, and if employers are to forego the practice of benevolence in its true sense, a bolshevik rule is the best that they can expect or even deserve. And unless welfare work is fostered by generosity it will be too uncomfortable to endure. Good housing conditions in isolated manufacturing villages are part of welfare work, and if laborers' houses are built by a mean man the laborers' family life is spoiled. Generosity is essential.

If the "industrial missionaries" who are said to have supervised welfare work are efficiency engineers, we think the point well taken. They cannot solve the labor problem. If they are snobs of any description, the point is also well taken. But if they are wise and conscientious employment managers and district nurses and men and women who understand that the flowering of welfare work and benevolence and generosity is in co-operation, then we think that they are the only kind of persons who can supervise it.

Now let us consider the second sentence: "Enter manpower engineering." We do not believe there is any such thing. There might be slavepower engineering, but manpower engineering is impossible in a free country. Granted for the sake of argument, however, that it is possible, then it cannot be established upon identity of interest, because, if a man's judgment is not permitted to function he is playing a losing part despite high wages—unless he is a moron, in which case he should not receive high wages.

The idea of charging things to operating expenses is well established. Operating expenses are like the commercial traveler's expense account, and sometimes they carry a considerable burden, especially the burdens of error. We know of financially successful establishments surrounded by dirty, tumble-down tenements with bad Americans in the making in them due to lack of welfare work, rather than to low wages. In these instances the operating costs have been underladen—unless there were errors of judgment to boost them. But high operating expenses do not indicate good labor conditions any more than a high expense account indicates a good salesman. We do not think the second postulate in regard to the triumphal entry of manpower engineering established on identity of interest and charged to operating costs is illuminating. We're sorry to say that we can't see that it points toward greater enlightenment. It is not the key to the labor problem.

We wish the English language were held in higher esteem than it is, and that it were used with greater discrimination.

Readers' Views and Comments

Does American Potash Need a Fixed Price?

To the Editor of Chemical & Metallurgical Engineering

SIR:—The editorial "Does American Potash Need a Fixed Price?" in your Sept. 1 number has come to my attention. Will you permit me to point out certain facts which I think the writer of the article has overlooked?

In the first place, the American potash producers were not responsible for the schedule of maximum prices included in the bill now before the Ways and Means Committee of Congress. The original bill as drawn by the Department of the Interior and introduced in the Senate during the preceding Congress did not contain any such provision. The maximum prices were inserted by the Senate Committee on Mines and Mining, and were included in the present bill only because of the insistence of members of that committee. The potash producers have always feared that the inclusion of this schedule of maximum prices would tend to prejudice their just and equitable demand for protection from German dumping, and when the Ways and Means Committee of the House, during the recent hearings on the bill, suggested that these prices had better be eliminated from the bill, the attorney for the United States Potash Producers' Association immediately approved the suggestion on behalf of the producers. (Page 222, Hearings before Committee on Ways and Means on H. R. 4870.)

The potash producers have repeatedly stated that all they need is a brief period of protection to make the readjustments incidental to changed conditions. This period they have placed at five years at the outside and two years as an irreducible minimum. The better and more up-to-date plants can probably do with two years. On the other hand, some of the smaller plants will doubtless be unable to reach a competing status in five years. But the point to be marked is that the industry asks only a limited and temporary protection, and the producers firmly believe that with such a brief period of safeguarding they can put their plants in a position to compete in the open market with any potash sources on earth.

The reduction of costs to be effected during this temporary period of protection fall under two heads: First, amortization, including obsolescence. Built under war conditions, practically all American potash plants now represent a very heavy construction cost. In addition, since quick production of large tonnage was urgently demanded by the situation of the country and by the insistence of Government officials, large sums were spent on machinery and equipment of an experimental nature but on a commercial-sized scale. In other words, there was no time for elaborate laboratory and semi-commercial tests. As a result, equipment representing large sums has been scrapped and stands on the books today as a dead loss. Quick amortization of part of this excessive construction cost and cost of obsolescent equipment is essential to put the companies on a sound operating basis, and is a just and necessary charge against the product. Figures for amortization in two years were included in the estimates submitted to Congress at the express urging of the War Industries Board. Second, improvements in operating practice. During the war the one essential thing was to get out a tonnage of potash. Reduction of costs both by refinements in operating methods and by development of by-products was a secondary matter and in fact received very little attention. With the passing of the war conditions such reductions of cost became of course of the first importance and are receiving the most earnest thought from American producers.

Two considerations operate against the possibility of effecting such reductions over night. In the first place, it takes time to devise, secure, install and shake down new machinery and labor saving devices to smooth operating conditions. It takes time to determine the possible by-products in raw materials, devise methods of recovery and arrange for marketing such by-products. In the second place, without a reasonable assurance of permanence for the industry, such as would be given by the temporary protection asked for, the necessary credit cannot be secured to finance the new installations and improvements.

Your statement, therefore, that "the American industry can stand on its own feet and can now compete with foreign importations, barring dumping, trade war, rebates and such unfair practices," is not in accord with the facts. The present quotations for foreign potash range from $1.50 to $1.70 a unit. Our producers cannot now meet these prices, but will be able to meet them and possibly lower them in a few years' time if protected from unrestricted European importations during the brief readjustment period. The American producers quite agree with your claims that with correct technology they will be able to compete, but they claim, with justice, in my opinion, that they must have a brief time to install equipment which shall be technically correct, and time to reduce somewhat the excessive capital investment which now stands against the plants.

The preference of the potash producers for a licensing measure instead of a protective tariff is based primarily on the fact that with a license system the consumer will get his potash cheaper than under an adequate tariff. With a license system such part of the country's demand as cannot be supplied by American producers can come in from abroad at a lower price, thus giving the farmer the benefit of cheap foreign potash, while at the same time furnishing American producers with a definite market. With a tariff the price of all potash would be raised to the level of American costs of production, and the American producers fear that such a measure would not secure the final approval necessary to enact it into law. This is set forth on page 79 of the recent hearings on House Bill 4870 before the Ways and Means Committee.

I shall be glad if CHEMICAL & METALLURGICAL ENGINEERING will publish the foregoing statement so that your readers may have the viewpoint of the American potash producers.

FREDERICK W. BROWN,
Executive Secretary,
United States Potash Producers' Association.
Washington, D. C.

Willard Gibbs Medal Presented to Dr. William A. Noyes

The Chicago Section of the American Chemical Society presented the Willard Gibbs medal to Dr. William A. Noyes, professor of chemistry in the University of Illinois, at a banquet held in Chicago Sept. 26, 1919. Mr. L. V. Redman, chairman of the Chicago Section, explained the nature and origin of the medal, which is awarded annually by a jury of 12 to an outstanding figure in American chemistry. The award may go to either industrial chemists or those engaged in fundamental research.

Dr. William H. Nichols, president of the society, presented the medal after a short address in which he reviewed the work and character of the recipient. Dr. Noyes spoke informally on the subject of "Positive and Negative Valences," reviewing the development of the various theories and the apparent conflicts that still have to be reconciled before we understand thoroughly the constitution of elements and their compounds. The following brief statement of Dr. Noyes' work, written by Dr. Julius Stieglitz of the University of Chicago,

DR. WM. A. NOYES

is reproduced from the *Chemical Bulletin*, the lively and efficient organ of the Chicago Section.

Dr. William A. Noyes is a veteran leader in American chemistry, as teacher, as investigator and as a force in the American Chemical Society, ever working for high ideals and progress. As a teacher, he is most widely known for his textbooks in Qualitative Analysis and Organic Chemistry and his more recent texts in General Chemistry. In all of these books he approaches his subjects with a directness and saneness of thought and method, combining theoretical development and practical material, which make his texts singularly clear and convincing. In his research work he has covered an unusually broad field of subjects: to have done expert work of the highest character in the determination of atomic weights—he received the Nichols medal for his work on the atomic weight of chlorine—as well as extensive and important work in the more complex fields of organic chemistry represents a breadth of knowledge and power which it would be hard to duplicate in any other man, not only in this country, but throughout the world. In recent years, Dr. Noyes has taken active interest in the most important and most absorbing problem of the day, the electronic theories of valence and atomic structure, and has not only contributed ideas deserving of careful consideration, but has also carried out one of the most painstaking investigations looking toward the isolation of simple electromeric compounds, such as $N^{---}Cl^{+}$, and $N^{+++}Cl^{-}_{3}$. This breadth of chemical interest, combined with a character of sterling honesty and a mind singularly direct and judicial, found one of its most important and happy outlets in the service of Dr. Noyes as Editor of the *Journal of the American Chemical Society*. Through many years, with a unique devotion and self-sacrifice of time and strength, Dr. Noyes brought our major journal to its present high standing among the chemical journals of the world.

All honor is due this modest, productive leader in chemical thought and chemical service to our country.

Production and Exportation of Mercury in Spain

Mercury is produced in the Provinces of Ciudad Real, Granada, and Oviedo, but the most important mines are those of Ciudad Real, which are located at Almaden and cover a surface of 485,187 acres. They are owned and operated by the State.

The Estadistica Minera de España contains some interesting statistics as to the cost of operation of the Almaden mines during the year 1917. In this year excavations were made at 300 sites, at which 2765 cu.m. were excavated at a total labor cost of $97,333. The average daily wage paid was $2.50. The average labor cost per cu.m. was $35.20. The archwork, solid walls and masonry erected for the interior support of the mines cost, for materials and labor, including transportation, timbers used for bracing galleries and shafts, etc., a total of $155,477. Shop expenses for work not let out by contract amounted to $15,931; the various articles classed as accessories cost $81,658, and labor not otherwise specified added $44,498 to the expense.

For labor used in distillation during 1917 the expenditure was $76,132, and for supplies $82,148. Ten pairs of Bustamante subliming furnaces, two Cermak-Spirek, continuous-movement furnaces for fine materials, and three double-pan furnaces of the same system for coarse ores were employed. In the Bustamente furnaces 7550 tons of mineral were treated, from which were produced 984,486 lb. of mercury. In the Spirek system 688,795 lb. of mercury were produced from 5616 tons of ore.

The exports of mercury from Spain for the years 1908 to 1916, inclusive, were:

Year	Lb.	Year	Lb.
1908	2,353,629	1913	2,746,386
1909	3,069,959	1914	2,099,978
1910	2,466,935	1915	2,694,394
1911	3,293,392	1916	1,752,538
1912	2,769,085		

A comparison of the figures of output and export shows that practically the entire production is exported—chiefly to Great Britain.

Exposition of Chemical Industries, Chicago

WHILE the doors of the Chicago Coliseum and First Regiment Armory opened on the Fifth Exposition at 12 o'clock noon, Monday, Sept. 22, the formal program ushering in the event was held at 8:20 in the evening of the same day in the auditorium of the Coliseum building, with Mr. Charles F. Roth, Exposition manager, acting as chairman.

The addresses given by men of prominence and high standing in the industrial and chemical world sounded the keynotes on matters vitally interesting to those engaged in the chemical industries and to the general public. The industrial worker can find salvation from present trying conditions, and happiness for us all, in application to his labors and research for our needs. The science of chemistry has found production of additional wealth in by-products from many processes. We must depend on industrial patriotism, and by the use of sound economic principles deliver all from the chaos caused by inapplicable theories and the terminology of vari-defined phrases. The path of the present-day chemist in his progress through the research period is infinitely easier than of old.

Welcome by Dr. Redman

Dr. L. V. Redman, in greeting the visitors, said:

We welcome the Exposition to Chicago as the first to be held in the West, and while it cannot be hoped that it will be held here as frequently as in New York, we wish to persuade the exhibitors that the advantages afforded by this location are fully as great. The exhibits show the marvelous results of five years' intensive research. In chemical discovery mankind has advanced a full generation, bringing with this progress a corresponding rise in the prices of commodities, and these prices are here to stay. We may be something of Bolshevists about our hours of work, but this is only the result of a relaxation after the concentrated effort during the war period, and in a few months such spirit will pass away. Due to this rapid development we now are witnessing perhaps the greatest chemical exposition we shall ever see.

The chemical industry will move its center to the Western field. In 1910 the automobile manufacturing centers were along the Atlantic coast, but now the Middle West holds the greatest output. Chemistry is doing the same thing. Two per cent of all the chemists in the United States have come to Chicago during the last year, and the total number of chemists in this city has increased 25 per cent in number during the same period. Production of meats, cereals, steel, coal tars, dyes, pharmaceuticals is carried on in this locality and the center of production will be here in a short time.

We should observe that the average salary of the chemist has increased from $1200 or $1500 per year to $3000, and while general prices have also risen, the salary increases has been in much greater proportion.

The four qualifications for a good chemist are ability to labor, research, discover and organize. The most remarkable document of the twentieth century, forgetting the League of Nations, was the one drafted by the Federation of Labor and presented to Congress in which it was stated that *the one means by which the workmen can develop better conditions exists in research*, and that Congress should do everything possible to encourage it.

The doctrine has arisen that men believe there is plenty of wealth available for all and that the trouble is not due to distribution but to production. The laborer realizes his hope is in research and is to be congratulated on this point of view. If all the money of all the millionaires were distributed it would keep the country running only two weeks. Therefore, if the laborer keeps the thought of research and production before him he will produce the greatest happiness the country has ever known.

Gov. Lowden's Letter

A letter from Frank O. Lowden, Governor of Illinois, dated Sept. 18 and addressed to Mr. Roth, was read, as follows:

"When I accepted your very much appreciated invitation to address the Fifth National Exposition of Chemical Industries, it was with the qualification that if I were in the State on Sept. 22 and if no unforeseen contingency should arise. It now happens that I have been summoned to appear before the Appropriations Committee of the House of Representatives at Washington to discuss budgetary reform. Perhaps you know that Illinois in 1917 provided the machinery for an executive budget and has since been operating under it very successfully. I therefore feel it my duty to respond to the invitation from Washington and give the Appropriations Committee the results of our experience. I think you will realize that this is one of the most important subjects before the country and that it is my first duty to help Congress in any way I can in this very important matter.

"I wish you would present my greetings to your associates and assure them that I am deeply disappointed because of my inability to welcome this most important body of men to our State. Our people learned during the war the overwhelming importance of chemistry in war. I trust that they may now learn that those connected with the chemical industries can be equally helpful in the beneficent work of reconstruction in times of peace."

Letter of Charles H. Herty

Charles H. Herty, in a letter addressed to Mr. Roth, dated Aug. 28, wrote:

"This morning President Wilson officially authorized me to act for American interests in dye questions abroad. This makes it necessary for me to sail next Wednesday, and I expect to be absent from six to eight weeks. In connection with this matter one of my chief regrets is that this unexpected duty will take me away at the time of the Exposition. I am sure you know how much this grieves me, as I have been present on every occasion heretofore at the opening of the doors, and I regret especially having to miss this particular time in Chicago.

"Will you please convey to Governor Lowden my sincere regret that I shall not have the pleasure of hearing his words of welcome? I know you will be able to find some one who can make more fitting reply than I might

have made. I am writing to the chairman of the Chicago Local Section expressing my regrets. Good luck to you, and best wishes for unlimited success to the Fifth Exposition."

Address by Charles F. Roth

Charles F. Roth spoke in part as follows:

"Some few years ago it became our duty to take inventory of our industries to learn our ability to meet the enemy in war. Some months ago it became our function to examine our businesses to their vital parts to know their ability to meet the changed views and demands of the world. Business will not go back to its old methods; the war has taught greater efficiency and its requirements to manufacture all over the world. We must examine into the fundamentals of our operations and, regardless of our present methods, consider the reactions in the processes involved, construct a program and then, comparing it with our present methods, make changes here and there where needed. We must look into the chemistry of our work and methods; its laws are immutable, but they may be made to operate through different channels. Those are the things we must weigh; are our present channels the most efficient?

"Chemistry, today, is playing its most important part in industry and as time goes on will play an ever increasing part; the business that is not founded and administered upon an honest chemical basis, using the most modern and efficient chemical equipment and processes, will be a laggard and failure in the commercial race. American chemical engineering has shown during the past four years its ability to meet all emergencies and the competition of its enemies. There are many manufacturers who do not realize that their organizations and businesses are built upon some chemical truth, that the origin of their business is founded upon some familiar chemical reaction, which, in its many phases, did they know them, would open whole vistas and ranges of thought, new fields and endeavors to them.

Chemistry's Part in Industry

"All the mechanical industries and the arts use or adopt the products of the chemical industries for their purposes. You will further realize upon a moment's reflection that the chemical industries are the wealth-producing industries, for by them the raw and worthless material is converted into a useful and valuable product, the mechanical industries enhance through manufacture by form that which has already been made valuable, the arts give the intrinsic value to some few of the product of the mechanical industries. Humanity adds the sentimental value. There you have the whole gamut of values as they are brought into being. At the fountain head of all this is chemistry. It is the basis of life and industry. Even agricultural pursuits might be counted as a chemical industry, for we soon see that unless the soil is replenished with the constituents removed by the growing plant it becomes unproductive.

"Did all business men sense the value of a chemical study of their processes and place them upon a scientific basis, the result would put our domestic industries in an unassailable position, incomparable with the rest of the world.

"Inquire of the leading firms in every industry for the reason of their leadership. They know that the application of the imperative laws of chemistry to their operation has brought it about. The greatness of Chicago's packing house lies more in the chemical utilization of the waste than the shipping of the prime product. The greatness of the gas house is not in the gas, but in the dyes and pharmaceuticals made from the tar it recovers."

Relation of the Chemist to the Manufacturer

John W. O'Leary, President of the National Metal Trades Association, spoke on "The Relation of the Chemist to the Manufacturer," as follows:

"It is always a pleasure to see and hear loyal Chicagoans, and I thank Dr. Redman for his boost, for his words are true and I believe Chicago will become a big steel center. I am happy that the privilege has been accorded me to participate in the proceedings of this meeting of the National Exposition of Chemical Industries. I had no part in selection of the subject, which permits me to say what I wish.

"I was impressed last week in the East with the fact that we are facing a very critical and serious situation in the United States. I have always tried when thinking in terms of the great war to dwell not so much on its cost in money, in health, sacrifice or supreme loss of life, but more on the gain to the world through the war. It would be unfortunate if we forget the debt we, as survivors of the awful struggle, owe to those who fought the good fight and won for us world liberty. None can do them too much honor, and we would be ingrates indeed if we failed in our daily life and expression to give thanks to God and them for the victory. It seems to me, however, that we would be showing small appreciation and little reverence if we now only devote ourselves to acknowledgment of our debt by erection of monuments, memorials to those who won the war. The cost was too great, the struggle too long, to be content with such expression. We should rather feel the duty ours to honor them by accepting as our task the rebuilding of the world resources destroyed, the conservation of the resources remaining and the preservation of the lessons taught by experience.

Opportunity for Chemical Leadership

"To you men of the chemical industries comes the opportunity to lead in these tasks. The war brought to all of us a realization of your value in almost every branch of industry. One of the oldest of professions has come into its proper sphere of importance. For, during the war, whether the need was a greater destructive explosive, a more dangerous gas, a more brittle steel, or a more ductile, the science of chemistry was the agency to which we looked. Or if the demands of armies called for more of cloth, or wood, or paper, or leather, or silk, or anything which natural resource or productive capacity could not supply, the chemist was called on to create the substitute.

"And now that we are realizing the effect of interrupted production, and of wholesale destruction, when we are realizing the economic cost, and the difficulty of supplying even our current needs when we know that it is essential that we also restore the lack in these years of war before equilibrium can again exist, what an opportunity is yours to serve the world! The awak-

ening of industry in general to its need for your assistance was marked during the years immediately preceding the war. The twentieth century began with such an appreciation.

"I have been interested all of my life in the steel industry. I have heard my father speak so often of the shipment of steel rails to the United States from England during his early manhood, and of the excitement over the discovery of the bessemer process. I have watched with interest the later development of the open hearth, and the impetus which that development gave to the industry. But it was not until the chemical engineers developed the use of alloys in steel, and the wonderful magic effects of heat treatment, that the full possibilities of the steel industry became apparent. Today the chemistry of steel makes us feel that no matter what phenomenal results have been demonstrated recently, more phenomenal results will occur, and that there is no more important factor in the further development of the steel industry than chemistry.

The Utilization of By-Products

"But it is not sufficient that you have improved materially the quality and uses of steel, you have been developing at the same time the by-products, which for so many years were wasted. In so doing, you are making us independent of Germany and her tar compounds and adding materially to the wealth of the United States. It is noticeable that while almost every commodity has increased in price since the armistice, steel has been reduced, and that in spite of higher costs, in actual production of the steel itself. This has been made possible largely through the utilization of the by-products. It is entirely within the realm of possibility that the by-products of steel manufacture may bring profits equal to those of producing steel. Whatever the gain, it will mean much to the future prosperity of the United States.

"Today, we are the only great producing nation in position to carry on normal industry through finance, natural resource and comparative immunity from destruction of life from the war. While we are not taking full advantage of our position, because of industrial strike, we will recover quicker than others. Eventually, however, we must meet competition which will demand the keenest efforts. The farther we advance in utilization of our by-products to carry the cost of manufacture, the better we will meet whatever the balance of the world offers in competition. What has been accomplished in the steel industry is indicative only of the importance of chemistry in almost every basic line. The extravagant, wasteful methods which we employed in the use of our forest resources is forcing attention now. Through the use of preservatives we must conserve what we have left; and it is your province to develop those preservatives.

"The importance of the growth of your industry in the basic chemical field of chemicals, drugs and dyes, is clearly shown in the comparison of our export figures for those articles in 1913 and 1917. Our imports from Germany in 1913 amounted to $21,000,000. Our exports in 1913 to all countries were $30,000,000, while in 1917, partly due to higher prices, but still representing large increase in volume, our exports amounted to $188,000,000. Surely no other American industry can show such a ratio of increase. The war gave both impetus and protection permitting this vast expansion. American initiative, courage, and legislative protection must be forthcoming to continue onward progress. And so I might continue, if time permitted, to enlarge upon the importance of the relationship of chemistry to industry. You know, better than I can tell, how vital your field is to industry. But what of the preservation of industry itself? It seems to me that our industrial progress has for the past year been backward rather than forward, and no gathering of business men at this time should fail to recognize the seriousness of our present trend, and seek for the cause and cure.

"During the war, and more particularly since the armistice, we have been passing through successive stages of higher wage demands, higher profit demands; less hours, less work; more leisure, more extravagance; less responsibility, less patriotism; of course, the result is bringing higher costs, and a progress toward disaster. Economic truths have been discarded for theories which sound well but won't work. We are confused by a plethora of general terms, undefined in our own minds or in the minds of those who utter them. Living wage, collective bargaining, profiteering, labor as a commodity, partnership of capital and labor, the right to organize, shop representation, combination, a new era, democracy in industry, socialization of industry, are some of the terms used each day in every publication; in every forum. *No one attempts to define what is meant, because every one has his own interpretation, and they nearly all differ.*

"The great mass of American workingmen just want to work—the great mass of American employers just want to produce. They both recognize that they are inter-dependent and have co-operative interests, and if permitted to carry on, other conditions will correct themselves. But they too are confused by what is after all nothing more or less than an insiduous Socialistic propaganda. Not that all who are striving to express their understanding of the multitude of new thoughts are Socialists. Many are honest, well meaning folk who have assumed a paternal interest in industry but are in no way responsible for its continuance, nor have they any practical knowledge of its conduct. Others are selfishly interested in the propaganda because it furnishes them their daily bread. Others are employers who either through conscientious belief or pressure have adopted new plans of relationship and are anxious that they not conduct their experiment alone. And industry suffers! *Five months of honest productive effort of American industry will supply all of our own needs, and permit of seven months' effort to replenishment of the world. Yet at our present rate of progress, we are unable to supply our own needs.*

Germany's Productive Man Power Unimpaired

"Until recently, all Europe was pursuing similar tactics. Each nation's industry was striving to emulate the progress of Russia under Lenine, who has put into force all of the theories which we are talking about, as he understands them. I do not know whether his interpretation isn't likely to be as correct as any of ours. But today, at least two of the nations who have been passing through this after war orgy are recovering. Belgium is no longer striving to see how few hours she can work, but rather how many hours bodily strength and health will permit. Germany, under pre-war conditions a wonderful industrial nation, has lost heavily in man power. But before the war 3,500,000 of her

men were constantly removed from industry for military purposes, and millions more were engaged in supplying those 3,500,000. Today there is no such drain on her industrial man power and the release of this burden more than offsets her losses during the war. They have stopped talking about the eight, seven or six hour day, and are ready to devote ten, eleven and twelve hours a day to restoring her industrial position.

"Whether or not we are living in a new world, or a new era, the same sun shines, the same God rules. None of the formulas of chemical reaction have changed. We continue to progress in the discovery of new things, but they do not develop over night. Time and honest effort, not laws or theories, will make the discoveries available for service. Progress must be step by step, and each step will succeed only as the proper reagents are used. I remember from my days in chemistry that it required hydrogen and oxygen to produce one of the necessaries of life; that it required two parts of the hydrogen and one of oxygen to accomplish it; either a different element or different proportion meant failure. If we substituted sulphur for the oxygen we made an awful stench. *As I see it, industrial relations operate similarly to chemical relations. To reach proper results we must rely upon employer and employee, and in their proper proportion. Too much power on the part of either will not make the compound desired.* The substitution of another element will make a stench, and the addition of another element will not produce the desired result.

Importance of Labor Conference

"Two weeks from today the Labor Conference called by the President of the United States will assemble in Washington. Its importance to industry is emphasized by the request of the President to union labor to await results of the conference before inaugurating further strikes. The corollary is that if results of the conference do not follow the desires of the Federation, strikes will follow, and we must continue the disastrous experiences of the past year. It is important, therefore, to analyze from the President's speeches and trend his views on proper solution. He has expressed his belief that society sanctioned the eight-hour day; he has approved collective bargaining, though not clearly defined as to method; he has said that he would offer a new basis for wages; he has indicated that workmen should be partners in industry; he has advocated placing employees on the boards of directors; he has shown sympathetic approval of the organization of all workers. As I indicated earlier, much depends on the interpretation we give to terms or words. *Under any interpretation, a program based on immediate adoption by American industry of these principles would result in chaos.* Unrest is too keen for the launching of any definite plan of development of theories which, whether good or bad, must be gradual in their presentation; adopted only after experiment in a small way has proved their success, and debated and studied when men are calm and their judgment keen, rather than under hysterical and restless conditions.

Increased Production the One Thing Needed

"I hope, therefore, that all men of industry who meet together, whether employer or employee, will consider the seriousness of our industrial future, calmly and without passion, and I hope that as a result of such thought they will express to the President their hope that in this critical period of unrest no radical suggestions be inserted to further complicate conditions. Industry is in no position to absorb further departures from established practice than are now being tried. The general public cannot add to the burden being carried by them. Increased production is the only method which will make permanently possible improved standards of living or working conditions.

"Our greatest need today is for a reawakening of the patriotic impulses created during the war. Now, the slogan should be *'Industrial Patriotism.'* Today we need not so much discussion of rights of capital and labor as two opposing classes, but rather a campaign for industrial patriotism. The war awakened in us a spirit of enthusiasm for country and flag, dormant for many years. The reaction at its close is dissipating a great national asset. Selfishness is reasserting itself. Under the spell of national stress we all labored, not as classes, but as Americans all. The nation is in serious peril if we continue to drift industrially as we have since the armistice. Opportunity invites us, as American citizens, to prosper, and as American citizens, not as classes, we should accept, and fight together for commercial supremacy of the world.

How Long Does It Take to Develop a Laboratory Process Into a Dividend?

Herbert H. Dow, speaking on this subject, said:

"Almost everyone is interested in connecting up his profession with a dividend. LeBlanc, who was the founder of the first chemical process that attained any magnitude, spent about 15 years in building and attempting to perfect a chemical plant for the manufacture of soda ash. During this time the French Revolution impeded his work seriously, and the newness of his ideas made his problems more difficult to solve than those we now encounter in similar work. After spending all these years without attaining his goal, he became discouraged and died by his own hand. About 55 or 60 years later, Ernest Solvay had perfected a laboratory process for the manufacture of soda ash; after spending about 10 years in perfecting the process of manufacture on a large scale, it attained commercial success, and a few years later it became one of the most phenomenally successful processes ever devised. It is very difficult to obtain information in regard to the details of development of these processes that are only known to us through the various publications that have been made from time to time. For this reason I think you will be more interested in hearing of the development of processes that I know more about.

The Bromine Process

"The bromine process of the Dow Chemical Co. was first conceived in the summer of 1888. A small commercial plant was built in 1889 at Canton, Ohio. This plant was a commercial failure for a number of reasons, among which were the lack of business experience and also the inadequate supply of raw materials. In the summer of 1890, another commercial plant was erected at Midland, Michigan, using electrolysis instead of chemicals for setting bromine free from its combinations in the brine, and unlike the method then generally employed, it used air instead of steam to blow out the bromine. This plant also was a commercial failure because of many things, among which were the inexperi-

...ce of the management, and also the fact that the process was a little ahead of the times. I can best explain this last by an illustration:

"We wanted an electric generator having a capacity of 500 amp. at 15 volts. We wrote to all the manufacturers of generators, and most of them that thought a reply to our little concern was worth while stated that 15 volts was too high a voltage, that plating vats had already been tried, connected in series, and found to be a failure, and that 5 or 6 volts was the highest practical limit. True, 120 volts for lighting purposes was standard at that time, but the idea of making 30 or more electrolytic cells and connecting them in series looked like too radical a departure. The manufacturers also said that 500 amp. was too big a current to commutate properly, that it would burn up the commutators in spite of the best design then known. We finally succeeded in buying the type of generator we required and installed the little plant in an old barn. Every part of this plant gave trouble. The generator in particular required constant attention to prevent the commutator and brushes from being burned up, and under the most favorable circumstances the cost of electricity for the commutator attention alone was a large item.

First Plant a Failure

"Finally, in spite of working 18 hours a day, more or less, the plant became a commercial failure, and the company was reorganized with two new partners to supply additional funds. After operating in this way for a few months it became apparent that it would again be a failure, and my first partner, who was a man of successful manufacturing experience, stated that the trouble was that we were trying to operate on too small a scale, with too little capital. We therefore attacked the problem from the financial end, and six or eight months later we began the erection of a relatively large plant. It called for a 50-kw. generator, and in the spring of 1892, I went to Cleveland to purchase this huge dynamo. The man in charge of the General Electric office after a considerable time asked me how large a 50-kw. generator was. Another firm offered to furnish it in three units, saying that it was impossible to run such large units continuously.

First Dividend Paid in Six Years

"We finally succeeded in buying the generator, and six years from the time we started commercial work we paid our first dividend. This illustrates how the interval of time between the successful laboratory process and the dividend was lengthened by the demands of the process being in advance of the electrical art at that time. More accurately stated, the electricians were too slow for the chemists. If the modern cell had been in existence at that time it would not have been a commercial success, because there were no suitable electric generators, but for the much higher priced bromine, with its higher electrochemical equivalent, the imperfections of the generators were not fatal to the electrolytic process.

"Analysis of the brine we were working on showed that it contained a larger per cent of magnesium chloride than other brines in this country, and we began to do research work with a view to extracting it profitably. About that time I learned that a number of carloads of iron sulphate had been sold for $3 a ton. We found that by precipitating the magnesia from the brine with lime and mixing it with ferrous sulphate and exposing it to the air it would slowly oxidize to ferric hydrate and magnesium sulphate. We decided that the best way to carry out this reaction was to spread the moist mixture of ferrous sulphate and magnesium hydrate on the floor of a long shed and cultivate it with a horse and farm cultivator once a day for several days until it was completely oxidized, and then remove it with a horse and scraper and add a new batch in a similar way. We went so far as to buy some leather boots for the horse but found that they had a very short life owing to the destructive action of the chemicals, and this, together with the difficulty of getting magnesia in the first place free from common salt, caused us to abandon this process.

Ten Years Developing Magnesium Chloride Process

"From time to time other processes for making either magnesium sulphate or chloride were evolved, and tested out in the laboratory, and several of them were tested in a semi-manufacturing plant. Finally, in 1913, one of these semi-manufacturing plants made magnesium chloride in what appeared to be a very satisfactory way, and we therefore started the erection of a large plant. This was completed in August, 1914, a week or two after the war broke out in Europe, and when the Dow Chemical Co. began to sell magnesium chloride in carload lots within 30 days after war was declared, we began to be heralded far and wide in chemical circles as a very progressive firm that was able to get to manufacturing a heavy chemical on a commercial scale in 30 days. In this case, the first dividend was in reality about 10 years after the conception of our farmer process with its horse and cultivator.

"By this time we had a fairly large research and development organization, and practically every chemist in the plant was anxious to get his routine work out of the way so that he could work on some new process. In the fall of 1914 the price of carbolic acid had begun to soar and was attracting the attention of chemists everywhere. One of our organizations conceived the idea that monobrombenzol could be treated in an autoclave with caustic soda with the production of carbolic acid. It was already known that monochlorbenzol would make carbolic acid under these conditions, but the necessary pressure was 3000 lb., more or less, and we knew that the bromide would work at a much lower and more practical pressure. Actual tests showed that a high grade of phenol could be made without exceeding 300 lb. pressure. As this was within the commercial limits for fairly large pieces of apparatus, we immediately began the construction of a small plant.

"About the same time another group of our chemists thought they could make phenol by the process described in the literature. They tested it out in the laboratory and encountered no serious difficulties, and a semi-manufacturing plant was constructed and the various minor difficulties encountered were overcome. Then the price of bromine began to soar, and it became apparent that this process would entail too much investment in bromine to make it practical, so it was dropped and the old method adopted.

Success of Phenol Plant

"The first plant built had an estimated capacity of one ton per day. It turned out its first product on the first day of November, 1915, and in this 30-day month

produced 59,000 lb., which was only 1000 lb. short of the capacity which had been estimated from the small-scale plant. This was the first time in our history that we had gone from a semi-manufacturing plant to a real manufacturing plant without experiencing troubles and months of delay. We attributed our success to a much larger and more mature development organization, and the further fact that after an organization once learns how to develop one chemical manufacturing process, it is much easier to develop another. In this case, the laboratory process and the dividend were less than one year apart, but we must take into consideration that the very abnormal war prices made a profit much more quickly obtainable.

"A high official of one of our largest electrical companies once stated to me that they had to figure on five years from the drafting room to the dividend on any product which was materially different from their normal line. The fact that the United States Government during the war could actually accomplish in six months or a year what an old experienced organization could not accomplish in a much greater length of time can be explained only on the ground that men of very unusual ability, and in much greater numbers than any commercial enterprise could command, were giving their services and the utmost energy which they possessed to the rapid development of these products so urgently needed by the allies. Aside from this fact, in the case of the Government, it was not necessary that costs be reduced to a point which would be essential for a dividend in a private enterprise.

"It is our experience that the method of evolving a successful process is somewhat as follows: The laboratory works out the process and compares it with the state of the art as shown in the literature, and if results would seem to justify the effort to make the process commercial, some further laboratory investigations are carried out, and then the laboratory force, without an exhaustive study of the subject, tests it out in a semi-manufacturing plant, made of commercial materials instead of glass and porcelain. Here a number of new problems will present themselves and will have to be worked out by the research men. After this plant is in successful operation, the draftsmen start their work for a large plant. In the meantime any uncertain points are still being investigated by the research organization, but an exhaustive study of the subject is not made in the research plant, as we have found by experience that there is no limit to the investigations that may be made at this stage, and many of the points which might be worked out would take months of valuable time which could better be employed at other work, even if we take some chances on a process not thoroughly developed. Finally, when the commercial plant begins to turn out a product, it is inevitable that certain details will have to again be worked upon by the development organization and the troubles remedied. Of course, in developing any new process, it is necessary to carry the laboratory work to a point where both the purity of the product and the yields are sufficiently satisfactory to make a commercial success; and a few hours spent with beakers and test tubes in the laboratory may be the means of saving days in the semi-manufacturing plant, and in a similar way, it is much cheaper to perfect a process in this semi-commercial plant than in the ultimate commercial plant.

Some Personal Reminiscences

"A new organization usually lacks some certain knowledge or experience—either business or technical—which constitutes a weak link in the chain. Again let me illustrate: Just after I was graduated, I made an analysis of a brine for a man in Canton, Ohio, for which I was to receive $100, but after I had sent in that analysis I did not know how to get the $100. If I had known as much about the customary methods of doing business as an ordinary clerk, I would have accompanied the analysis with a bill. When we got our first barrel of potassium bromide, I attempted to sell it. I first went to a school friend in Cleveland who was in the wholesale drug business. He did not use bulk bromides, but he took me to a man just starting in the brokerage business, to whom I stated that the price of potassium bromide was 35c a pound, but we were willing to sell it to him for 25c, and we were about to close a deal, when he said: 'By the way, these bromides are strictly U. S. P., are they?' I said: 'No, they are not strictly U. S. P., but they are equal to the best on the market.' He immediately replied that he could not use them, so I left him and went to an old reliable chemical house in another city.

"Here I explained that our goods were strictly U. S. P. in all respects but one and in that one were fully equal to any brand on the market. They said that they bought their goods from firms of high reputation, and that they did not dare buy from a little one-horse concern in Michigan, that it would affect their reputation if they did. However, they said they had a little business where purity was not so important and they might buy a little if the price was right, and they finally offered me 17c a pound, just one-half the market price. I accepted an order for two barrels and went back to Midland. We opened up the barrels of bromides to see if they looked exactly right. Here and there we found specks, and they were not in as good form as they should be, and we spent most of the next two days picking over the two barrels of potassium bromide crystals to remove every speck or imperfect crystal. We then shipped the two barrels and waited for a remittance. When a letter eventually arrived it stated that they had examined the bromides and found that they were not strictly U. S. P. and asked what concession in price we would be willing to make. That letter sent my heart down into my boots. We needed the money very much. We had closed the deal as we supposed at one-half the market price, what further concession should we now make? Fortunately for the future success of the organization, there happened to be a business man in our office who volunteered to answer the letter. In substance our reply was as follows: 'We are in receipt of your letter of recent date. If the goods are not satisfactory, please return them.'

"I was so scared that the goods would be returned that after signing this letter I was afraid to put it in the postoffice, but finally did, and the next letter from the firm contained a check in full settlement of the account. This letter was another step that shortened the time between the laboratory process and the dividend.

The Value of Recording Instruments

"While we had expected to operate the plant night and day, our working capital got down to a point where this was practically impossible, so we cut the for

down to the lowest limit and employed only a watchman at night. It was the duty of this watchman to keep up steam in the boiler and keep two deep well pumps operating so that we would have a full supply of brine to work on the following morning. Watchman's time detectors were not as common then as now, and recording steam gages were only just beginning to be used. We thought that these were unnecessary in our case, because we could tell by the amount of brine pumped during the night whether the watchman had kept the pumps running regularly, but for some unknown and mysterious reason the pumps kept breaking down at night.

"The man whose duty it is was to repair these wells became very suspicious that Henry, the night watchman, was taking a nap occasionally and then in order to make up for lost time, was speeding the pumps up to a point that caused breakages. After these night breakages had occurred several times, I decided to go down to the plant along about the middle of the night and see if the watchman was asleep, but he had a little black and tan dog, and before I got within a hundred feet of the plant, the dog commenced barking furiously, and when I got to the boiler room I found Henry attending to business as usual.

"We were about to let Henry go and get another night watchman, but before doing so we decided to make sure of our suspicion by buying a recording steam gage, and secretly installed it in a closed box in the office. The first morning after it was set in operation we went down with a great deal of interest to see just what had happened during the night, but found that the steam line was very smooth and even and had been maintained at just what we desired. This caused us to believe that Henry did not take a nap every night but did so only occasionally. But when night after night the steam chart continued to report a smoother, evener pressure for the night than it did for the day, we realized that our suspicions were unfounded and that Henry was really an unusually good night watchman. I think the advent of recording instruments marked the turning point in development from small-scale manufacture, where the proprietor had everything under his own eye, to large scale work where organization and automatic equipment is brought into fullest effect. If Mr. Solvay had had some recording pressure gages, it might have reduced materially the 10-yr. interval between the conception of his process and the dividend.

"In the case of the Parsons steam turbine, which was the first in the field, Mr. Charles A. Parsons made a statement before the English Parliament just before his British patent expired—which was 14 years from the date of application—that he had made no money, and asked for an extension or renewal of his patent. After investigation, an extension was granted.

"In all radical inventions, where public prejudice is a factor and a general campaign of education is necessary, it would appear probable that 10 years, more or less, would be consumed in making a new process profitable. While there are a great many statements in regard to the great length of time required to perfect the first indigo process, there are no data that tell when the earlier small plants began to be profitable. It is now more than ten years since the first indigo was made in one of the laboratories of the Dow Chemical Co., but no serious effort was made to commercialize this process until after the war started, and about three years after it was decided to build a commercial plant the process became profitable. However, we had the advantage of much of the previous work done by others, which very much shortened the time required.

"Future development organizations will have the aid of better laboratory equipment, more perfect organization and greater experience, but to offset this, processes in future must be more highly developed in order to meet the prices of competitors who are continuously making their plants more efficient. We therefore leave it to yourselves to judge, but we trust that the few examples given may act as signposts along the way."

Motion Pictures

The program of motion pictures held each evening of the Exposition week in the Coliseum auditorium covered a large variety of chemical and industrial subjects and nothing could have been done by the managers to more fully insure the enjoyment of the visitors than this feature of the program. The profit derived by viewing the many reels exhibited was everywhere favorably commented upon.

Opportunities for Retired Technical Men in the Consular Service

Particularly gratifying results have followed the appointment to consular posts in chemical centers of men who had specialized in chemistry. This is one of the reasons why the consular bureau is looking more and more to the appointment of men with technical education to posts where their training will be of special value to the United States.

Due to the fact that the scale of pay in the consular service is not sufficiently high to be attractive to young men who must rely entirely upon their salaries, hope is being entertained that engineers and other technical men who have retired from active practice of their profession may be induced to take the examination. Service as an American consul abroad carries with it various desirable perquisites which would have compensatory value to many men who are not dependent entirely on their earnings, to say nothing of the very valuable service they would be able to render the industry with which they had been connected.

A consular examination will be held in the late fall or early winter and it is expected that it will be taken by a considerable number of retired technical men. Under the present statutory limitations, no consuls other than those of the first class are appointed except by competitive examination.

Calcium Superphosphate.—Calcium superphosphate made from phosphate which has been ground to pass an 80-mesh sieve, but not finely pulverized, is sifted or otherwise mechanically treated to separate the superphosphate particles, which are larger than the original phosphate particles, from the inert matter and calcium sulphate, which are not larger than the original phosphate particles. (British Patent 122,897—1918. E. A. GAILLARD, 3 rue de Batignolles, Paris. April 2, 1919.)

Observations Made at the Show

The best notes on the Exposition that we have seen are to be found in the advertising pages of our Exposition number. We say this without blushing. There are the illustrations and the facts. In what follows we shall give only random notes made in passing, gossip overheard, and memoranda recorded at various meetings at the Auditorium.

The Hough Nitrator shown last year by the Buffalo Foundry & Machine Co. was displayed in another unit and with slight modification. Aside from nitration it has found a variety of new achievements that are likely to bring it into general use. The main problem in nitration, of course, is the bringing together into contact, as nearly as possible, every particle of each of the substances; in other words, it is a problem of intimate mixing. This Hough apparatus is specially indicated in mixing oils of the type, say, of lubricating oils. To effect a proper blending of these mixtures as now accomplished by bubbling air through them often takes from 24 to 30 hr., while the product is often oxidized and thus darkened in color. This nitrator, it is claimed, completes the mixing in from 1 to 2 hr., does it better, effects a mixture of any desired proportions and in either large or small quantities. In an apparatus of 2500-gal. capacity the entire contents pass through the whole system twice every minute. The nitrator may also be used in washing a great variety of products at temperatures from those of cooling brines to those of superheated steam.

Another impressive exhibit of the Buffalo Foundry was a 2500-gal. caustic pot made of a special quality of cast iron to withstand the action of the alkali and heat.

A vacuum drum drier was in operation drying sulphite waste liquor and doing it successfully with remarkable speed. The operation is continuous. It is available for tanning extracts, soluble coffee, powdered milk, egg powder and a long list of pharmaceutical food and other chemicals. Still another exhibit was a vertical rapid circulation evaporator for concentrating foaming liquids and materials that demand a minimum exposure to heat.

While visiting at the booth of the Dow Chemical Co. it developed that this company is a large producer of pharmaceutical chemicals. And it is said that the largest use for bromine in the country is for medicines, the natural inference of course being bromo-seltzer. Sales are said to be increasing, which is a surprise, because we were under the impression that the requirement for bromo-seltzer would be retarded by prohibition. This, however, is not the case, from which we gather that near beer, grape juice and even loganberry juice may all be deadly and productive of drunkards' stomachs which were portrayed with such alluring art in red and purple in the days of our youth. The second largest demand for bromine comes from the photographic industry, which also consumes 30 per cent of the silver produced in the country.

Fused magnesium chloride ($MgCl_2.6H_2O$) is made in very large quantities by the Dow establishment. This is used chiefly in the manufacture of magnesium oxychloride cement for interior work, which is of such interest that we plan to publish a separate paper on the subject later.

At the symposium on America's Case in Chemistry Dr. J. Merritt Matthews revised his figures as to the time when we shall have all the vat dyes we need that are made in America. At the Philadelphia meeting of the American Chemical Society Dr. Reese prophesied that we should have them within six months, which Dr. Matthews doubted. In the meantime he has visited a number of works and at the Exposition he predicted that we should have all we need by the end of the current year. That's a little more than three months.

In the exhibit of Roessler & Hasslacher considerable attention is paid to their peroxide products which are used for bleaching. Under the trade name of "Albone" they prepare a 25 per cent by volume solution of H_2O_2 which is shipped in barrels as far as from Perth Amboy to Iowa without deterioration. It stands for months with practically no decomposition. We see a chance for research in the use of peroxides for bleaching in laundries and from the way in which the prices of shirts and collars are soaring we wish they would hurry. Chlorine as a bleaching agent is a grand thing for the shirt and collar makers, but the ultimate consumer is rarely able to appreciate the benefit. The same concern also shows peroxides of the alkaline earths and of other metals. Zinc peroxide is used in surgery and in toilet preparations.

An interesting item in the exhibit of the National Aniline & Chemical Co. is a specimen of moiréed silk ribbon dyed with Dr. William Perkin's original mauve. His discovery of this dye and its tinctorial power marked the beginning of the coal-tar dye industry. Sir William presented it to ex-President W. J. Matheson, in 1906, shortly before his death.

Another unusual feature is a line of certified food colors made in a building erected and equipped for the purpose and in strict accord with the Government requirements. The main exhibit, of course, has to do with the company's large line of colors, including the following vat dyes: alizarine, indigo, carbanthrene olive (from carbazol) and alizarine sapphire, all of which are declared to be available in quantity. Within little more than one year's time this company has added 24 dyes to its list and made them available for commercial use. It is doubtful if any German establishment can show such a record. The company maintains a great research laboratory.

Two new products are shown by the Barrett Co. One is a synthetic resin called Cumar which looks important. It is made by the polymerization of two coal-tar oils which come over at about 172 deg. and 182 deg. C. respectively: cumarone and indene. It has great promise as a varnish gum and owing to its dielectric properties its use is indicated in molded insulation work. It is insoluble in water and alcohol, but readily soluble in turpentine, benzene and other commercial solvents. It serves also as a binder for various molded material. The second, phenanthrene, is available as a substitute for wax in paper and may be taken as the raw material in the synthesis of various morphine derivatives.

The Shawinigan Electro-Metals Co., Ltd., distributed a valuable booklet on the uses and qualities of magnesium. It includes details of foundry practice and a chapter on alloys.

When Dr. Augusti Rossi received the Perkin metal he announced that by the precipitation of a titanium solution by means of an organic acid he obtained the oxide in a state of very fine division. Ground with oil, it showed remarkable covering power as white paint. The exigencies of war prevented its manufacture on a commercial scale, but now, through a corporation called Titanium Pigment Co., Inc., it has been put upon the market under the name of "Titanox." This consists in a mixture of titanic oxide and barium sulphate in proportions of about one to four. Its covering power is decidedly greater than that of either white lead or zinc white. Tests show that it does not crack or check as readily as lead or zinc paints and that in the latter pigments the checking and cracking may be avoided by the use of 50 per cent or more titanox mixed with it. After long exposure titanox paints chalk to a moderate extent, but mixtures of lead or zinc oxide with titanox are more durable than any of the paints alone. An interesting showing is made.

Major Harrison E. Howe of the National Research Council said in talking of its plans at the general meeting in the Auditorium on Thursday, Sept. 25, that there are about 275,000 manufacturing concerns in the United States, of which less than one-fourth of one per cent have laboratories of any kind. Not over one-eighth of one per cent have laboratories worth mentioning and not over 50 in all have research laboratories.

He gave some details of the research organization for alloys which the Council is helping to organize. The plan is to have it more largely composed of manufacturers who need alloys than of those who make them. This is a wise move, and it is in the interest of economy, because it costs a lot more to introduce a new thing, whether it be an alloy or anything else, than it does to make it on specification. And it is also much more likely to bring improvements into use if users know they can be made and need them. It puts the shoe upon its proper foot. One hundred members will be enough to constitute the organization, and these are to contribute $100 each per year for five years. While they will probably require their own central laboratory in time, it is proposed for the present to make use of existing commercial laboratories.

Initial steps are being taken for the formation of other similar associations. In all its work the Council seeks to avoid duplication of effort.

At a general meeting held at the Exposition Auditorium on Sept. 25 Mr. C. Price Green told of the field for industrial development along the lines of the Canadian National Railways. He gave some very interesting statistics, as for instance, that the United States, with 1/15 of the population of the world, uses one-half of the paper made upon it. Just as the writer's bosom was beginning to swell with pride over this he was reminded that all the Hearst papers were published in this country and that there are a considerable number of anarchist papers published not only in English but in foreign languages or that these latter constitute the only literature of any kind that reaches a good part of our foreign population. Then he cooled down. The Chicago *Tribune* uses the wood from 30 acres per day. All the Chicago newspapers use up 5000 spruce trees daily.

Canada produces 90 per cent of the world's nickel, a large proportion of its silver, 85 per cent of its asbestos. It contains the largest known gold mine, and a vast amount of copper. Deposits of sulphide ore have lately been discovered that are so rich that they are profitably hauled 60 miles for shipment by railway.

Graphite is under development by the Timmins people and he predicted that within a year's time there will be offered for sale from this source graphite that is equal if not superior to that imported from Ceylon and Madagascar.

There are marble deposits in Central Ontario that are the oldest on the continent and of unsurpassed beauty. The bodies are of immense magnitude and run for hundreds of feet in depth without a flaw. As the strata lie in a vertical position, the various varieties can be obtained with great economy. Water power is available for the operation, while the product may be run down to the railway by a gravity road.

Only lately manufacturers have begun to realize what potent factors chemists and engineers are. There is great need of technically trained men in that country.

In an address made by Dr. Arturo Liebes of *El Mundo* (a Havana newspaper) he displayed motion pictures of Cuba and her industrial life, he made an earnest appeal along lines that we have touched upon editorially. He protested against the type of representatives sent by American manufacturers to represent them in that country. He said that of 250 such men that he had met, nearly all were outspoken critics of Cuba and Cubans. Many of them made fun of their customers. They had no sympathetic viewpoint with the people. Whatever was done differently from the way current in the United States was wrong, according to these gentlemen. He earnestly hoped that a greater effort would be made to select the right type—which means a more cultured, sympathetic and affable type of export salesman for Cuba.

A clever exhibit made by the Semet-Solvay Co. was a miniature dairy farm covering about 3 sq.yd. Beside each building or field was a label indicating the Semet-Solvay products that are useful. The dwelling house, for example, could use domestic coke, while for the roads calcium chloride was needed to lay the dust. Beside the garage it was recorded that benzene was available for automobile fuel. The chicken house required coal-tar disinfectants and germicides. In the creamery calcium chloride is needed for refrigeration, salt for the stock and for the creamery, while soda is required for cleaning. In the field the use of potash and ammonium fertilizers was indicated.

Another Solvay exhibit was a model in pyrex glass of a cotton-boiling kier designed by Mr. Scott for use in bleacheries to overcome a difficulty from which they suffered. A number of these kiers have been installed and are in successful operation. Their merit consists in the treatment of cotton with caustic in the absence of air, whereby the formation of hydro-cellulose is prevented. After the caustic is drawn off and the wax thus removed the cotton is washed with water and finally bleached in the kier, thus providing for a minimum of handling.

Chicago Meeting
Mining and Metallurgical Engineers

Engineers of the Chicago Section entertained the 120th meeting of the American Institute of Mining and Metallurgical Engineers during the week of Sept. 22-26. It was a remarkable meeting in many ways, breaking all records in point of attendance, and in the number of technical papers presented. On Thursday, for instance, between the hours of 10 and 6, about 53 contributions on modern pyrometry and its industrial applications were presented to a largely attended joint meeting of the Institute and the Electrochemical Society. On other days as many as three simultaneous sessions were being held, while the many attractive trips of inspection, the Chemical Exposition, and the meetings held by five other engineering societies made it a difficult matter for the individual to be at the right place at the right time. Unfortunately for the local committee, as well as the visiting metallurgists, the steel strike badly disarranged the excursions planned, since under the circumstances it was impossible to visit any of the extensive steel works in the Chicago district. The usual banquet was held, which was addressed by President WINCHELL, and Messrs. PEABODY, ROBINSON and SCHWAB, where the underlying note was one that the engineer would be of enormous economic value in the next few years by promoting the necessary spirit of confidence between worker and employer so necessary for our industrial renaissance. Captain COUBLVT, of the French Navy, also spoke, recounting briefly the relation between the present mineral and metallurgical resources of France and their expected needs, together with an outline of the methods by which they expected to bridge the gap.

A very interesting group of about 20 papers on non-ferrous metallography and metallurgy were presented by title only, since they are to be the subject matter of a meeting of the Institute of Metals Division to be held the following week in Philadelphia, held jointly with the American Foundryman's Association, as is customary. These papers will be noted in detail in connection with a later report of this meeting. Pyrometric subjects will not be considered at this time, being reserved for special treatment at length in subsequent issues of CHEMICAL & METALLURGICAL ENGINEERING. A very important series of papers by FULTON, KELLER MACKAY, HANSON and HULST on non-ferrous metallurgy must also, for lack of space, be deferred for later notice at length.

Monday, Sept. 23

Session on Milling

A paper in defence of the Chilean mill was presented by LUTHER W. LENNOX, assistant superintendent of the Portland mill, Victor, Colo. He pointed out that this type of grinder has fallen into disrepute of late years, and that in two published tests where they were operated on the same kind of feed alongside ball or tube mill the results were unfavorable to Chileans. However, the feed in these cases was exclusively fine; in other words, the mill was used as a re-grinder, while tests at the Portland mill have demonstrated that a certain amount of relatively coarse material is necessary, upon which the mullers may ride, and which eally act as auxiliary grinding units. Under this condition, with feed which may contain slabs 1 in. thick and 3 in. square, the millers and die are 2 in. apart at their edges and contain 5 in. of mixed sizes closely packed at the middle. With a feed exclusively finer—say, minus ½ in.—the mullers plow their way through the ore instead of rolling over it, and a much thinner bed of material is retained in the grinding zone. Results of a large number of tests are included to support the ideas of the author, while the records show that the mill will reduce the hard, refractory Cripple Creek ores from minus 2½ in. as follows:

Open circuit:	Tonnage 24-Hr.	Size Product	Tons Hp-Day
With 6-mesh screens	275 to 300	28.5% —200 mesh	2.5
With 18-mesh screens	240	32% —200 mesh	2.2
With 30-mesh screens	175	35% —200 mesh	1.75
Closed circuit:			
With 6-mesh screens	200	42% —200 mesh	1.86
With 18-mesh screens	185	47% —200 mesh	1.72
With 30-mesh screens	130	52% —200 mesh	1.31

The mills described consist of a battery of six 6-ft. Wellman-Seaver-Morgan Akron Chilean mills, each driven by a 100-hp. motor at 37 r.p.m. Power input is maintained at 110 hp. as near as possible, of which 10.7 represents friction in mill, motor and transmission. In the paper may be found detailed information as to relation of grinding efficiency as it varies with tonnage, dilution of pulp, speed of mill, position of muller, and screen analysis of feed, together with figures of steel and screen consumption.

Mr. C. H. BENEDICT, of the Calumet & Hecla Mining Co., observed that they had displaced a 48-unit Chilean installation by ball mills because their service was to grind $\frac{3}{16}$-in. material to very fine sizes. For this work the ball mill is evidently superior, reducing the time lost for repairs from 3 per cent. to less than 1 per cent., while a uniform sized discharge is impossible from a Chilean, owing to progressive screen wear.

Mr. R. B. T. KILLANI of the Hardinge Conical Mill Co., pointed out that since the Miami tests referred to by Mr. Lennox were run, considerable advance in ball-mill practice had been registered. Using figures from Mr. Lennox's paper presented at the Colorado meeting on the relative "grindability" of various ores, which have been independently verified, Mr. Killani calculated figures which indicated the probable superiority of the ball mill on equivalent work, figured to mesh-tons per horsepower.

GRAPHIC METALLURGICAL CONTROL

H. M. MERRY, metallurgical statistician for the Chino Copper Co., Hurley, N. M., presented a short paper on "Graphic Metallurgical Control," in which he pointed out that the customary method of having several zero points on the same ordinate is likely to produce confusion in interpretation and to militate against its full usefulness. He shows that a logarithmic division of ordinates is more to be preferred, in that the low numerical values, such as "copper in tailing," are properly magnified to their true importance, as compared,

for instance, to the figures for "copper in concentrate." An even better ruling is the plain millimeter cross-section rolls wherein the notations roughly follow the mean logarithmic spacings for the region in question, but in this portion the plotting is on an arithmetical scale. The author also describes an ingenious wall cabinet for filing old charts in such a way that they are protected, yet instantly and easily accessible for comparison or study.

Crushing Practice at Ajo, Arizona

Additional information regarding the crushing practice at Ajo, Ariz., was given in a short note by W. L. Dumoulin, assistant general superintendent. It was found that when a carload (35 tons) of ore from the shovel pit was dumped into the coarse crusher (No. 24, style K, Gates) set to 9 in. it would pass material so rapidly that the four No. 8 crushers set just below receiving the discharge would be flooded. Concaves and mantles were therefore replaced, so that the larger crusher now breaks to 6 in. and the lower set to 3 in., instead of 4 in. as formerly. This distributes the work more evenly in the coarse crushing plant and takes much work from the secondary Symons disk crushers. A new unit has been installed in the latter department, making 5 in all, with a total capacity of 500 tons per hr., each consisting of one crusher, with a grinding surface 4 in. wide, reducing the ore from 3 in. to ¾ in., followed by two with surfaces 6 in. wide, delivering ½-in. material (only 18.3 per cent. through 20 mesh!). Repairs on the Symons machines have been reduced by strengthening various details and eliminating more of the tramp iron. Manganese steel used per ton of ore crushed is 0.0113 lb. in the Gates and 0.059 lb. in the Symons.

Tuesday, Sept. 23
Session on Iron and Steel

(Jointly with American Electrochemical Society.)

Raymond M. Howe, of the Mellon Institute, presented a paper on "Blast-Furnace Refractories," in which he collects the results of a questionnaire sent to nine of the leading American furnace plants. Seven of the firms reported satisfaction with both furnace and stove brick, while the failures noted were due to obscure causes which would require detailed study to determine. Thus the refractory industry feels that it has probably met the more and more exacting demands of modern metallurgy with considerable success. The author points out the fact that fire-brick manufacture comprises seven distinct steps, each of which may be adjusted so as to influence quite definitely the quality of the finished product; makers are now giving close attention to all these matters, so that their product will suit the intended purpose as to melting point, density, strength, toughness and uniformity. On the other hand, it is obvious that the purchaser has much to gain in studying and specifying his exact requirements and then insisting that a correct mortar is used and the furnace is built exactly according to the engineer's drawings. When the useful life of the lining is passed, the furnace should again be carefully studied before dismantling starts. Only in this way can progress be effected. Disintegration of blast-furnace linings has been variously ascribed to the effect of carbon, deposited at 300 to 400 deg. C., to removal of iron by gases, and to deposition of alkali. The author points out that if the first two causes are effective, linings could be made more durable by using an iron-free brick or by keeping them constantly above 400 deg., either of which is obviously impossible. On the other hand, there may be great savings made by developing a top-lining with a hard, impervious, refractory glaze.

Effervescing Steel

Two papers on the effect of gas in steel attracted much attention. The first, a clear exposition of the causes and results of "Effervescing Steel," was given by Henry D. Hibbard. He notes that the pyrotechnic display of burning steel particles splashed up from the ingot top during and after pouring is due to the evolution of a myriad of gas bubbles, the gas being rendered less and less soluble with decreasing temperature of the liquid. Three zones of blow-holes are caused by such gases entrapped in the mushy steel: First, holes near the surface due to hydrogen. These are relatively rare, because ordinarily but little hydrogen is present and its bubbles are largely washed away by the evolution of the enormous quantities of CO, which is responsible for the deeper-seated holes. Finally, at or near the axis are sometimes found cavities due to residual nitrogen or NH_3. Effervescing steels include most soft steels with less than 0.40 per cent. C, and when properly made (according to the principles laid down in the paper), the ingot will have a flat top with but few holes near the surface due to hydrogen. Even these, if covered by a thick skin of sound metal, so that they are unoxidized, will be welded shut during rolling. The deeper-seated holes are always bright and constitute no defect; in fact, they should be just sufficient in volume to produce a flat-topped ingot, in order that the minimum percentage of billet ends will be cropped.

Determining Gases in Steel

The second paper on this subject was by J. R. Cain, of the Bureau of Standards, who outlined the work which is under way toward developing a correct method of determining gases in steel. In a brief review of the previous work he noted that the simplest method in use, i.e., of drilling the metal under mercury and collecting the gases liberated, gives reliable qualitative results and indicates that a part of the total gas content is held imprisoned between crystals. Heating steels in vacuo is difficult and show that various amounts of gas are evolved at various temperatures, indicating, in fact, that fusing the samples will be necessary before quantitative results may be expected. Work along these different lines has disclosed considerable gaseous segregation; that rolling decreases the gas content; that the gases evolved are mainly H_2, CO and N_2; that the solubility increases with temperature and as the square root of the pressure. Detailed investigations have already shown that the Ledebur method of determining oxygen is inaccurate and valueless as an indicator of the physical characteristics of the steel itself, except in the rare case of very pure ingot iron, and that the gas evolved by Goutal's method is generated by carbides in the metal. The Allen method of determining N_2 is more promising, and many improvements in its technique are being made. Possibly it can be developed into the precise quantitative operation which is first needed before serious work can be started to determine the actual mechanism of the degasifying reagents (Mn, Al, Si); the effect of manipulation on gas content, and, finally,

how gas content affects the physical properties of the manufactured articles.

In the discussion of this paper, Mr. CUSHMAN pointed out that there were probably three separate methods of gas imprisonment; first, atmospheric air in cavities; second, gas in solid solution, and, third, combined in chemical compounds. J. S. UNGER pointed out that it is difficult to see how oxygen—which has been reported as being evolved from hot metal—can be present in quantity with such a large excess of iron or carbon. As a matter of fact, it is quite doubtful whether all gas in iron alloys is detrimental: witness the work which has been done on oxygenated cast iron and the growing use of gaseous cementation agents. Mr. YENSEN thought that other methods than melting in vacuo were necessary in order to get all gas from metal, since he has made many ingots held molten in vacuo for hours which are full of blow-holes.

THE EFFECT OF TIME ON PHYSICAL PROPERTIES OF MEDIUM-CARBON STEEL

"The Effect of Time on Physical Properties of Medium-Carbon Steel" was described in a paper by G. A. REINHARDT, metallurgist, and H. L. CUTTLER, assistant of the Youngstown Sheet & Tube Co. In their effort to produce forging steel of about 0.50 carbon and high elongation it was found that test bars which had rested over night gave much better ductility than those tested immediately after machining. Pursuing this matter further, the authors found that improvement by rest was apparently confined to bars cut from ingots, or pieces on which but moderate amount of work had been expended; that rest at 120 deg. C. accelerated the beneficial effect, and that the speed of machining on the test bar seemed to be an immaterial factor.

An animated discussion followed this paper. Many members had used the expedient of aging to get test bars past the specifications, but conflicting opinions were expressed as to whether the forging also improved correspondingly. The interesting ethical point was also raised as to whether it was correct to give a test bar a low temperature anneal—for that is what againg or accelerated aging really amounts to—in order that it may attain a certain physical specification.

AIRCRAFT STEELS

In a paper titled "Aircraft Steels," ALBERT SAUVEUR, of Harvard University, points out the confusion during the war which existed because of a multiplicity of aircraft boards, each working independently and constantly issuing revised specifications. No less than 175 different steel specifications had been more or less officially promulgated, when the Inter-Allied Committee on Aviation delegated some of its members to prepare some specifications truly international in character which could be issued to clear the chaos. Dr. Sauveur's paper is largely a reprint of this sub-committee's report, giving condensed specifications for chemical composition, recommended heat treatment and desired physical properties of elevent types of steel, some one of which would appear to be suitable for any particular part of an airplane where steel is desired. Fifteen other steels are included in a second category, in order to satisfy all members of the committee and to cover localized conditions of manufacture.

RIFLE-BARREL STEEL

Rifle-barrel steel was discussed in two papers by Major A. E. BELLIS and G. F. BUTTERWORTH, JR., of the Springfield Arsenal. These barrels are made of 0.55 C, 1.15 Mn steel in one of four ways: (*a*) by upsetting blanks, then quenching at 816 deg. C. (Ac = 732) and drawing for 2 hr. at 648; (*b*) by quenching billets from 816 and rolling at 677, (*c*) by rolling at or above Ac; and (*d*) by rolling at 650 to 675. Method *c* gives structure apparently sorbitic at 100 dia., but resolvable into rounded particles of free ferrite in sorbitic ground mass. Method *d* gives typical banded grains, the original structure not being obliterated, merely distorted. Methods *a* and *b* give similar structure of homogenous sorbite, substantially the same for all drawing temperatures, although the degree of heat can be determined microscopically by the tint after standard etching. In manufacture the occasional seamy pieces are almost always exposed, so that few failures result when proof-firing at 40 per cent. excess pressure. Erosion after continued firing is shown by tests to be resisted best by the true sorbitic structure, any network of free ferrite offering easily eroded channels for the scouring action of hot gases and metal.

Evening Session

A description, illustrated by lantern slides and moving pictures, of the huge 240-in. plate mill at Coatesville, Pa., was given by C. L. HUSTON. The speaker prefaced his remarks by a brief account of the development of boiler-plate manufacture and the rivalry which lately has existed between mills as to which could produce the largest plates for special purposes. This particular mill is so much larger than its predecessor that it will doubtless be unique for many years. Its construction, of course, involved the perfection of several radically new details in the stands, tables, manipulators and shears, all of which were clearly described.

FUTURE TREND OF MILL PRACTICE

ROBERT W. HUNT read his paper, suggesting the future trend of mill practice to attain a better grade of rails. Some seven years ago he instituted a special inspection, which has since been widely adopted with gratifying results. It consists of placing inspectors in all departments of the steel works at all times, charged with the duty of recording the history of each heat of rail steel. A copy of this is furnished the steel company, as well as the purchaser, so that in the life of any rail should a defect occur, not only a detailed record of its manufacture is available, but personal responsibility may be correctly fixed. Mr. Hunt has also recently recommended a nick-and-break test for each ingot, a practice which is now universally used on Canadian railroads. This merely consists in breaking a piece from the top end of the first rail rolled; if satisfactory, the whole ingot is accepted; otherwise, the bottom end of the first rail is broken, and so on until a fracture free from defect is found. Hot straightening of rails is another step in advance which is perfectly feasible, and which will when generally adopted materially cut the expense in this department, as well as result in improved and safer rails, with a much smoother roadbed. Use of liquid additions will enable more uniform chemical composition from basic open-hearth heats, while a

higher average carbon content could be secured if a certain percentage of marked rails with a small excess in carbon would be accepted by the railroads. Furthermore, there really seems no valid reason why all the railroads should not adopt the same chemical specification for their heavy standard rails, which, as a matter of fact, are about the same weight. Hot-top ingots seem not so far distant as a general requirement; milling both ends square, to precise length, is another matter of great importance. Hot milling about ⅛ in. of metal from the outer part of the blooms from which the heads and flanges of the rails are formed has been instituted by one mill, and the process is working to their satisfaction. Perhaps some such expedient will be needed to reduce the growing number of failures due to longitudinal seams and their accompanying crescent-shaped flange breakages, a tendency unchecked by the use of thick flanges.

Wednesday Morning, Sept. 24
Session on Iron and Steel

Impact strength was the subject of a lively discussion precipitated by F. C. LANGENBERG'S paper, where he described the results of Charpy tests on some forgings which failed in service and which, upon investigation, revealed low transverse ductility. The author considers that the test is of great value in testing ordnance material, basing his opinion on several years' use at the Watertown Arsenal in both routine and experimental testing. While admitting that notched-bar results are not yet directly correlated to more common physical tests, experience shows that low Charpy resistance or transverse tests indicates brittleness under suddenly applied stresses, a characteristic of the metal not revealed by static tensile properties on longitudinal specimens, even though low ductility transversely could be shown if bars were pulley in that direction. A. C. PICKENS gave a brief description of the machine in use at the Naval Gun Factory, which is a vertical drop machine, with graphic recorder drawing a curve of elongation vs. time. Velocity of stretch is given by the tangent to this curve at any instant; acceleration from time to time can then be easily figured, and with the weight of lower head known, a value for stress in pounds per square inch can be figured. This unit for expressing results corresponds to common practice in other tests, and will be an important factor in popularizing the method, especially since an integrating instrument has been designed for interpreting the graphs. On the other hand, Mr. NELSON said he had been experimenting with the Izod test for many months with the most erratic results. For instance, a sound carbon bar from stock, when split into sixteenths, would give tests ranging from 15 to 100 ft.-lb. in random sections within 4 in. of each other. Alloy steels, on the other hand, are either consistently good or bad; that is to say, if a certain bar is good "notch-test steel," one cannot get low Izod numbers by even the most careless testing, while a poor "notch-test steel" can have its resistance increased from Izod 4 to 10 up to Izod 40 or 50.

Cooling Properties of Technical Quenching Liquids

N. B. PILLING and T. D. LYNCH of the Research Laboratory, Westinghouse Electric & Manufacturing Co., presented a very valuable paper comparing quantitatively the "Cooling Properties of Technical Quenching Liquids." Using experimental methods developed by Benedicks, the cooling curves of a small cylinder of nickel in liquids at various temperatures were studied, and the derived data summarized in diagrammatic manner. In general, there are three different stages in the quench: (*A*) a layer of vapor is formed between hot metal and cool liquid through which the heat transfer is slow; (*B*) the vapor jacket is condensed, and cool liquid comes in physical contact with hot metal when heat transfer is quite rapid, each bubble of vapor as formed being swept away by convection currents: and (*C*) as the metal cools off, ebullition ceases in the liquid and heat is transferred slowly at temperatures below the boiling point. It is thus seen how the physical properties of steels are quite materially affected by the varying quenching rates common in practice. Quenching oils in general are quite stable; i.e., the curves for a given oil are nearly parallel at all reasonable temperatures, with speed and duration of various stages almost identical. Concentrated sulphuric acid also is stable (in the above sense) and gives high quenching values because Stage *A* (vapor sheath) is entirely absent. Brine is second only to acid in speed of quenching up to about 40 deg. C.; above that temperature Stage *A* appears and becomes of increasing importance. Tap water, on the other hand, is very unstable, always producing a considerable period of slow cooling before Stage *B* sets in, which period lengthens rapidly as the initial temperature of the water approaches its boiling point. A concentrated soap solution at all temperatures quenches slowly because the vapor sheath persists down to metal temperatures approximating 400 deg.

Heat Treatment of Cast Steel

An interesting account of the development of a double heat treatment for steel castings was presented by Messrs HALL, NISSEN and TAYLOR, of the Taylor-Wharton Iron & Steel Co. These men demonstrated to their own satisfaction that an anneal of from 2 to 4 hr. at 900 deg. C. was necessary to diffuse the original ferrite in low-carbon cast steel. This soaking must then be followed by relatively quick cooling to prevent the carbon re-segregating at the original grain-boundaries; air cooling was later replaced by oil or water quenching. A second anneal is necessary to remove hardening strains—it must be done below *A*, in order to retain the acquired carbon distribution. One peculiar result of their work was that it was shown that it is necessary to reheat to a lower point after quenching than after air cooling in order to prevent re-segregation of ferrite masses. Experimentation with electric steel of extremely low S and P content showed that practically the same heat treatment is necessary to eliminate ghosts entirely; the authors therefore conclude that good physical properties may be had more cheaply by heat treatment than by insisting on stringent chemical specifications. During the war, good results were had from a 0.25 C, 1.25 Mn steel perfected several years previously for dredge buckets. Intricate gun-carriage castings of this composition were made of basic electric steel, given the double treatment of quenching and annealing without the least trouble from cracking or difficulty in attaining the physical specifications.

American Ceramic Society Meeting

WEDNESDAY, Sept. 24, was set aside as Ceramic Day at the Exposition, and aside from visitation of the many booths devoted to ceramic subjects in the Coliseum and Armory the American Ceramic Society held its annual meeting under the direction of W. D. GATES, acting as chairman, and CULLEN W. PARMALEE, as secretary. The morning session was called at 10:45 o'clock in a conference room in the First Regiment Armory, and papers were presented in order as abstracted below. The Society is to be complimented on the progress being made through the efforts of its many active members in their combined effort to forward the state of the art to its highest standard.

Superior Refractories

In the presentation of this paper, the author, ROSS C. PURDY assumed that the audience had a clear understanding of present conditions in the ceramic art, because so much has already been published in the journal of the society and so much work has already been done by the universities and by individuals on the methods of testing, etc. The paper presented at the Philadelphia meeting of the A. C. S. on the same subject dealt with the need of the industry for superior refractories.

This is a plea to the American Ceramic Society to initiate, directly or through the agency of the National Research Council, active and thorough researches by a Federal Bureau, of our refractory problems. This recommendation is made in spite of a keen appreciation of the excellent work which has already been completed and at present being undertaken by the Federal Bureaus, the National Research Council, the American Ceramic Society, the Refractories Association, the American Society of Testing Materials and other organizations. Much has been done by our universities and much by industrial concerns. In the presentation of this plea there is no forgetting the advances we have made through the efforts of these several agencies and there is no thought but that these several bureaus, societies, universities and industrial concerns should continue independent researches on refractories as has been their wont, and as they no doubt are continuing, for there are advantages in independent investigations by several organizations each with its peculiar purposes, viewpoints, facilities, etc. Indeed we want more of this dispersion of interest and activity in researches on refractories. It would be well if each of the several bureaus, societies, colleges, etc., would see the great need there is for progressive and aggressive investigations of our refractory problems and each independently initiate and prosecute researches in this, the one branch of ceramics in which we are the most backward in meeting the industrial demands for a better product.

ADVANTAGES FROM A FEDERAL BUREAU

Notwithstanding this keen appreciation of the benefits derived from independent investigations and researches by several, we must recognize the advantages of unrestricted facilities, not alone in expensive and varied equipment to meet every desired requirement, but also in facilities for very accurate observations and for obtaining of trustworthy constants such as can be obtained only with highly trained investigators and expensive apparatus. We must appreciate also facilities for broad observations not alone in the development and manufacture of refractories but also the industrial needs for refractories. It is very obvious that the most rapid and the most certain progress in the development of refractories can be had only by an elaborate and aggressive investigation, an investigation that is beyond the possibilities if not beyond the scope of independent organizations of small financial resources and limited interest.

BENEFITS WOULD BE NATIONAL AND WORLD WIDE

Then, too, the benefits would not be alone to the manufacturers of refractories, indeed not as much to them as to the users, and to the national and world-wide welfare. It does not require much breadth of thought to realize how dependent is our present-day industrial progress on the development and manufacture of superior refractories, refractories that are superior for the several purposes than those now being employed. Consider for a moment the saving of time and of labor and of metal that is effected by the closed electric furnace over the open-top crucible for brass melting. The electric furnace today is melting less than 1 per cent of the brass used, and yet it is saving a million dollars' worth of zinc metal by reducing its loss from 6 to 9 per cent down to 1 per cent and less. In this one operation alone electric furnaces are not only saving metal but also labor, and at the same time are making the operation more tolerable for the operators. Examples could be multiplied by reference to the many heat-treating operations where with development of new equipment and processes they are effecting economies and bettering operating conditions. But these benefits cannot be fully realized until more suitable refractories are developed. The rapid development and adoption of electric furnaces for a large number of purposes has given rise to an urgent appeal for better refractories. The development and rate of adoption of the electric furnace has been phenomenal, but is greatly retarded by want of suitable refractories.

ADEQUATE SURVEY BEYOND THE SCOPE OF INDIVIDUAL ORGANIZATIONS

There is an urgent need today for an understanding of the qualities or properties that are wanted in each of the large number of industrial requirements. This is no small task. It involves accurate observations and study of possible variations in operation control in the place and under the conditions that refractories are used. It requires a knowledge of metallurgy and of ceramics and above all it requires an appreciation of the relation of costs to service. The most suitable refractory will at the best be a compromise, not alone because of the antagonistic properties that exist but also because of the economics of service involved. An adequate and worth-while industrial survey and research of refractory requirements is so far beyond the possibility and scope of individual organizations, and the benefits derived are so broad, affecting the cost and pleasure of living of every citizen, that it should be made under the auspices of a Federal Bureau, where the expense is borne by general taxation.

All Citizens Should Share in the Cost

If a discussion of the political economies involved were needed, it could be shown that since our national welfare is more and more dependent on industries as compared to agriculture and since the farm and the industries are today more mutually dependent than at any previous time, all citizens should share in meeting these costs. And if the economy considerations were carried farther, it would be plain that efficiency, relating to time and money expended as balanced against the value of results obtained, would require the employment of the broadest trained investigators, the most accurate and efficient equipment and the most liberal opportunities, all of which are possible only under Federal auspices.

Then, too, there should be extensive research of material resources and manufacturing processes. This should parallel the industrial survey. The two should be closely associated and each be given liberal support. A Federal bureau would secure for this a far better co-operation of the independent organizations than could any other agency, a co-operation that is very essential.

Progress in the Last Two Decades

A great deal of progress has been made in the last two decades, not alone in the refractories themselves, but also in our appreciation of the relative value of the chemical and physical means of judging their suitability. We no longer hear of the mistaken and much over-emphasized importance of chemical analysis of clays. We have not, and probably never will, discarded the chemical analysis as being without value. It has a value, for it does give information, but we certainly have less faith today in the empirical methods of Bischof, Seger and Ludwig for estimating the refractoriness of clay from the chemical analysis. We have learned too, that clays having the same chemical analysis but differing in physical and mineral character may have different values for refractory purposes. Indeed it is not uncommon that a freshly mined clay would have but small value for use in refractories, but will be made an excellent clay by merely weathering. This is an instance of the importance of texture and structural strength, factors that are not disclosed by chemical analysis.

We are appreciating more and more that the success of a clay for refractories is as largely dependent upon its physical properties that make it adaptable for manufacturing processes as it is on its chemical and mineral composition. Indeed, the fact is slowly being appreciated that behavior of a clay in the usual fusion test is dependent on physical properties as well as on its chemical composition. No method yet devised can be substituted for the direct fusion test.

Decided progress has certainly been made in knowledge of the method of study and progress has been made in the knowledge of what is essential in refractories, but we have made but little in the actual production for specific purposes. It is not the purpose here to elaborate upon the relative value of the several methods of studying refractory materials and wares or how to produce desired properties in the finished ware. We are making fair progress in these.

What we need today is the development of refractories that will remain practically constant in their physical and chemical characteristics through the maximum heat treatment to which they will be subjected when in use. We recognize that when a clay is burned in the firebrick kiln the melting together of its mineral constituents is but partly progressed and that further reactions and solution will take place when subjected to more severe heat treatment. We also recognize the importance of such factors as time, oxidation, etc., in the progress of clay fusion. It is well known that clay that appears equal in the fusion test will differ in load-carrying capacities when subjected to heat treatments much less severe than that required to cause them to deform in the fusion test, and we recognize this as one indication that suitability of a clay refractory is not wholly dependent upon its ultimate fusibility, but in fact is more dependent upon its rate of fusion.

From the evidence that is already before us it is apparent that for the most severe heat requirements, the refractory must have had its physical and chemical properties developed to their maximum; far beyond the possibility of alteration in any heat treatment to which they will be subjected in use. If fused bauxite, fused Alumina, sintered magnesia, or silicon carbide would meet all the industrial high-temperature requirements, there would be no need for this plea for Federal research on refractories. There are needs which these materials will not satisfy and for which such as the spinels, sillimanite, zirconia, etc., are better suited. We have heard much of the possibilities of zirconia as a refractory and have had several industrial trials of refractories made of zirconia, but we know little aside from the fact that we cannot yet produce a zirconia refractory that is economically possible. The same is true of sillimanite, a most excellent refractory of exceptionally low electrical conductivity.

The value of these fused refractory oxides lies not alone in their extreme refractoriness, but also in their constancy in volume, capacity to withstand sudden temperature change, resistivity to chemical and slag reactions, ease with which a desired texture can be produced. Refractory articles with these materials average much higher in desired or required properties than any of the partly fused or partly sintered refractories. No refractory will carry load at high temperatures and withstand the destructive abrasive slagging and temperature changes as will fused bauxite, silicon carbide, sintered magnesia. These same superior values may be found with other materials which have been previously fused. The great problem with them, however, is their production on a cost basis compatible with the service they will give. The solution of this problem is not easy and certainly deserves the serious attention of a Federal bureau, with its extensive capacity to conduct investigations in the laboratory and field.

Plea for Co-operation by Other Societies

The plea that is being presented is that the American Ceramic Society initiate and secure co-operation by the several other societies in a request for aggressive researches by some Federal bureau in the development and economic promotion of refractories. This will include a definition of the possibilities of clay refractories; an improvement in such as the silica and magnesite refractories, but especially should such a research develop and define the most economic method of production and use of such a superior refractory as can be made of zirconia, the spinels, sillimanite, the ni-

trides, etc. This is no small program. It will tax even a Federal bureau if executed with the vigor that the present urgent industrial demands fully warrant..

This plea is respectfully submitted to the Standing Committee on Research for their careful consideration.

Discussion

Mr. PARKER.—It is known that the Government made inquiries regarding certain clays during the war. The Government should be interested in the establishment of a bureau. Considerable work has been done in Pittsburgh. The execution of Mr. Purdy's ideas would make for great strides in the progress of the art,

Mr. HOWE.—Co-operation is a good iead in this connection. The Manufacturers' Association has found considerable saving would be effected.

Mr. W. D. GATES.—This paper is opportune. I hope this collective effort will be made, as it will cause ceramics to become an art indeed. Interchange of experiences has done more than any other thing for the day-working industry.

Mr. CULENDAR.—Mr. Purdy has made a very valuable suggestion, and if he will furnish us with a copy of his paper we will see that it is published in the journals of the Brick and Tile Manufacturers' Association and the Society of Testing Materials. It is to be hoped this paper will bear fruit.

Mr. SILVERMAN. — The manufacture of lapidolite would be benefited by the research work of such a bureau. When substituted for feldspar it eats through the pot ring in two or three days. There is need for such research in the manufacture of white glass as covered by Mr. Pratt's paper read before the American Institute of Mining and Metallurgical Engineers. The Ceramic Society is indebted to Mr. Purdy for his paper.

Mr. C. W. PARMALEE.—This paper is very interesting and the co-operation desirable. The National Research Council already has such a plan on foot. We should therefore co-operate with it rather than deal direct with the Government. The plan should be put through, but the method is in question. The work might be handled by another agency than by a government bureau. Ceramics is a key industry and the co-operative effort of the American Ceramic Society is a good example to the other institutes and societies.

ANOTHER MEMBER.—We should act immediately while other societies are in session in Chicago, and I move we request our Standing Committee to at once notify the Research Committee of the American Institute of Mining and Metallurgical Engineers of our activity in this direction. Motion was seconded and carried.

Mr. ROSS C. PURDY.—I have tried to express appreciation for the co-operative work already done, but for many purposes the clay refactory will not serve. As regards silicon carbide, slabs 10 in. long by ¾ in. thick have stood tests perfectly. Alundum has stood 50 lb. per sq.in. at 1400 deg. C. with knife edges used as supports for test piece. Two materials will not meet all tests required, however.

Mr. LINDBERGER.—Tests of fused bauxide and silicon carbide bear out Mr. Purdy's statements. They are not sufficient for all purposes, however. No. 1 fire clay softens below fusion point and ruins the structure. I suggest the use of superior refractories at vital points in the structure rather than in the entire body in order to strengthen and economize in cost of the work.

The laboratory is a hard place to determine all the requirements. The work should be handled by some bureau and on a commercial scale. Users of brick should be in close co-operation during progress of the investigations. Laboratory tests are good, but a bureau could make severe service tests to meet every condition.

Mr. SILVERMAN.—I suggest we include co-operation in the movement with all the societies.

The motion made previously was so amended.

The Past, Present and Future of the American Ceramic Society

This paper, by Prof. CHARLES F. BINNS, was very interesting. In part he said:

The American Ceramic Society was founded in 1899, at Columbus, Ohio, when a small group of scientific men, interested in the problem of silicate industries, gathered together and formed a permanent organization. Beginning with the report of that meeting a volume of Translations has been published each year for nineteen years. In addition to the annual volume, a Manual of Ceramic Calculations, as an appendix to vol. 11, and the works of Hermann A. Segar, translated from the German, were published.

The subjects which first claimed the attention of the Society were those concerned with the clay-working industries, the properties of clay, the various types of glaze, and the control of kilns. Befofre long, however, portland cement came in for a share of notice, to be speedily followed by sand-lime brick, glass and enamels for steel and iron. The necessary properties of paving brick were closely investigated, as was also the resistance of porcelain to electric tension. A glance through the early volumes of the transactions cannot fail to reveal the broad scope of the activities of the members and the earnestness of their application.

YOUNG MEN INTRODUCE NEW METHODS

At the opening decade the influence of the younger men began to make itself felt. Of the earlier group none had received training in a college of ceramic engineering. Facilities for such training did not exist. Some of the men had studied abroad, and all had graduated from the school of experience. The new men introduced new methods and contributed valuable enthusiasm. The use of engineering expressions became common and greater accuracy in investigations was manifest. The membership did not increase rapidly nor was the balance held by the treasurer an overwhelming burden. The policy of the Society was conservative. The motto was quality rather than quantity. This was sound practice, because the influence of the schools could not be expected to spread very rapidly and without a thoroughly trained personnel the industries could not greatly improve their methods.

NATIONAL GOVERNMENT INTERESTED

A notable step was taken by the National Government in the year 1909 when, stimulated by the demand for improved processes and fostered by the interest of the members of the Society, a department of ceramic research and development was founded in connection with the Bureau of Standards. Laboratories were opened at Pittsburgh and Prof. A. V. Bleininger was placed in charge.

Growth Since 1912

Up to 1912 there had been but one Local Section organized, the Beaver, later changed to the Pittsburgh District Section. At the annual meeting of 1918, charters were granted to six more, namely, the New York State, Northern Ohio, Central Ohio, St. Louis, New England and Chicago, while the Eastern Section was chartered in 1919. These sections hold meetings three or four times a year and are sources of membership, enthusiasm and general society backing. The four ceramic schools, Ohio State, Illinois, New York and Iowa, have student branches which are usually stepping stones toward membership in the parent society.

The growth in membership was steady but not large until about 1917, when conservatism yielded before a vigorous campaign under the Membership Committee, resulting in an increase of over 200, a movement which has continued up to the present, when there are 1156 members. In 1918 the annual volume of Transactions was superseded by the *Journal of the American Ceramic Society*, with G. H. Brown as editor. There has been a gratifying improvement in this journal during the year and three-quarters of its existence, and it now ranks with the scientific journals of much larger societies.

Formation of Divisions Necessary

As a natural result of large accessions of membership there came the formation of divisions. With a body so large it was obvious that every interest could not be adequately represented upon a general program. It was also obvious that special technical questions could best be discussed by small groups of men who were immediately and closely interested in them. The formation of divisions made possible the solution of the problem. There are at present the glass, terra cotta, enamels, refractories, brick and tile, white ware and porcelain, and wall and floor tile divisions. Their organization is being perfected and several have already made notable progress. It is expected that at annual meetings hereafter there will be one or two general sessions, with the remainder of the time given over to divisional meetings.

Future Holds Promise

The future holds much promise for the Society and for the industry it represents. Conservation of fuel will be studied, labor problems met, electrical energy utilized to the utmost, and the ceramist will seize the materials provided by the bountiful earth and will make them his servants.

Dr. Travers, of Great Britain.—The Empire encourages co-operative research of the manufactures, and for this purpose there is a fund of about $20,000,000 available. There is a non-profit co-operative company formed with the various concerns as members. A company appropriates a sum for certain research work and the government puts up an amount from one to five times as great depending on the nature of the work at hand. The company submits only a balance sheet to the government covering the expenditures, and is not otherwise interfered with. When the project becomes self-supporting the government withdraws its support.

Some Aspects of Scientific Research in Relation to the Glass Industry

Speaking on this subject, Dr. Edward W. Washburn said in part: Although one of the most ancient of the chemical industries, the manufacture of glass, like most of the other ceramic industries, has been one of the last to feel the influence of modern science. This is of course due largely to the fact that the industry, being older than the science, had necessarily to develop along purely empirical lines. The rule-of-thumb methods, and their accompanying "trade secrets," which characterize the development of a complex industry by this method naturally bred a conservatism of viewpoint which did not easily appreciate the value of scientific research or the advantages of scientific control over the materials and the processes of the industry. Furthermore, it must be admitted that until comparatively recent times the chemistry and physics of high temperatures, such as those prevailing in the most important processes of this industry, were so little developed that the science was scarcely itself in a position to render important service to the industry, such a service, for example, as organic chemistry has rendered to the synthetic dye industry, which is a typical example of a great industry built upon a highly developed scientific foundation and completely under the control of scientific methods and the results of continuous research.

Knowledge and Its Application Increasing

With the development of methods of producing controlling and measuring high temperatures in the laboratory our knowledge of the chemistry and physics of high-temperature processes has steadily increased and applications of that knowledge have naturally followed. The stimulus of the war has aided greatly in bringing together the practical man of the factory and the scientist of the laboratory. But in glass making we know *how* today much better than we know *why*. Progress demands that we know why. No industry which merely knows *how* is in a healthy condition. The feeling of confidence which comes with knowing the why of every step in the manufacturing process carries with it certainty of control, progressive lowering of costs, enhanced protection of the workmen, progress in the development of new and improved products and a degree of insurance against such evils as might otherwise attend the exhaustion or temporary scarcity of certain raw materials, fuels, machinery or other necessary supplies.

In the face of the imperative demands of war, or of the almost unlimited markets created by the destruction wrought by war, the necessity of operating with the greatest efficiency is not felt by an industry as it is in normal times with close competition and a market whose further expansion is dependent primarily upon lower selling prices. This is well illustrated in the case of the first two glass factories to resume production after the evacuation of Belgium by the Germans. These two factories, which I had the opportunity to visit this summer, are located in the same district and therefore subject to the same conditions regarding fuel, common labor and costs of materials. They are both engaged in the manufacture of window glass, for which for some time to come there will be an enormous demand for reconstruction in the devastated regions. In the first factory the glass is manufactured by the

older process in which the "metal" is gathered directly from the furnace on the end of the blower's pipe and then blown into a long cylinder which is cut lengthwise, transferred to the flattening furnace and there flattened into a sheet by a second workman. In this factory the blowers are paid from $250 to $300 per month. In the second factory operating under the Foucoult patents, the process is entirely mechanical, no labor other than that involved in the firing being employed between the point at which the "batch" is shoveled into the tank furnace and the point at which the completed pane of glass issues from the furnace. The highest paid workman in this plant received about 18 cents per hour. In spite of the apparently great difference in efficiency and in costs of the two methods of operation they are nevertheless both able to operate at a profit in a market where demand and not manufacturing costs is the principal element in determining the price of the product.

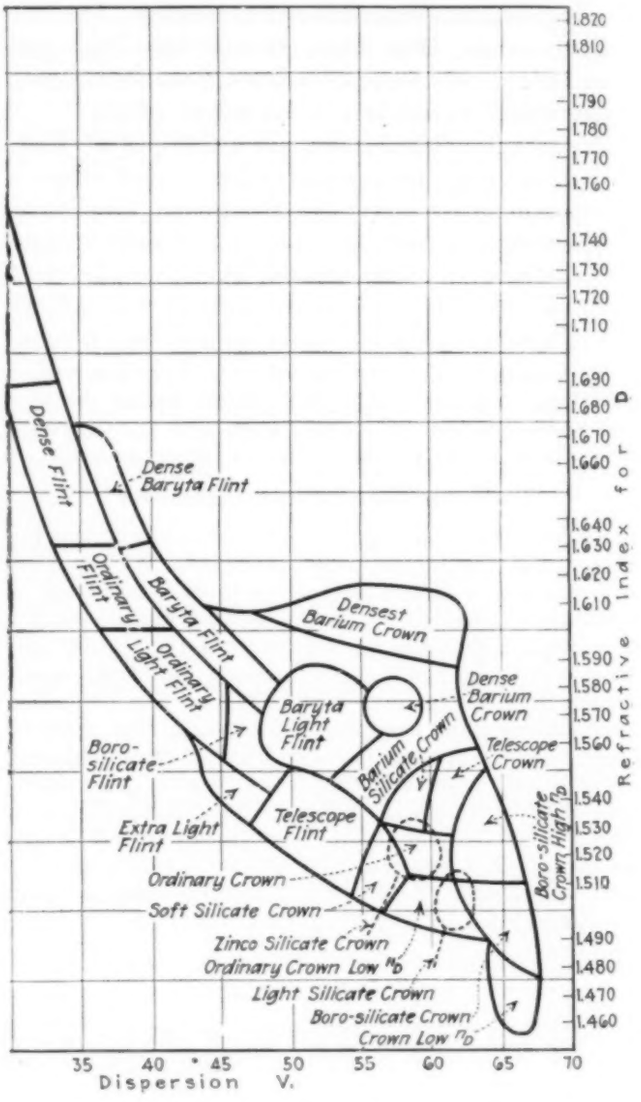
Work to Be Done in Industrial Laboratories

In industrial laboratories the work to be done may be roughly classified under three headings: (1) routine testing of raw materials and products and similar control work; (2) works problems, including the curing of troubles and the improvement of processes and products; (3) fundamental research to find out the *why* of the operations or to secure quantitative scientific data covering materials, processes and products. In the glass industry almost all of the fundamental research work remains to be done. For example, very little is known of the relations between (1) viscosity and (2) temperature and composition, although viscosity has long been recognized as of great importance in making and working glass. Surface tension and vapor pressure and even density have scarcely been studied at all.

Of the reactions and compounds we know almost nothing. The nature of gases remaining in solution is almost unknown, as well as their effect, if any, on the properties of the glass. Many unanswered questions are referred to, including relations between composition and properties, cause of greenish color resulting from substituting soda for potash, the condition of copper in glass, the cause of pink color from manganese, and red in chrome pink, the function of arsenic. These are only a few of the questions recently brought to my attention by an authority on colloid chemistry.

How Research May Be Prosecuted

There is thus no lack of chemical and physical problems in connection with the glass industry whose solution requires only the painstaking work of trained investigators. It is not enough, however, merely to point out the great need of fundamental research in this field; it is necessary that definite steps be taken to prosecute this research as vigorously as possible. Now, there are three types of laboratories in which research of this nature might be carried out. First, the research laboratories of the industry itself. These laboratories, while as yet few in number, may be expected to grow in number, equipment and personnel, and a portion of their resources should be devoted to some of the more fundamental problems common to the industry as a whole, as a part of their contribution to the general advancement of those branches of the physics and chemistry underlying the industry. Secondly, the government laboratories and the laboratories of research foundations, such as the Geophysical Laboratory. These may be expected to continue their work along these lines and should receive the support of the industry in their efforts to extend their facilities for such work. Thirdly, the laboratories of the ceramic departments of the universities. Now although we have some half dozen departments of ceramics in the country at the present time, these departments have grown up around and been fostered by the clay industries and have as a natural result confined most of their activities in the past to these branches of ceramics. There exists nowhere in the



United States a single professorship of glass technology. I believe that no one of the institutions at which a department of ceramics exists is financially able at the present time to expand its activities.

Scientific Leadership Passing From Universities to Industrial Research Laboratories

In the past the industrial world was content to rely entirely upon the universities for the advancement of science, but today there are many signs that scientific leadership is passing from the hands of the universities to the hands of the great industrial research laboratories and the privately endowed research foundations. Scientific research is becoming more and more costly

and the universities as organized at present can no longer compete on terms of equality with the efficiently organized and adequately financed industrial and endowed research laboratories.

Thus, although no longer entirely dependent upon the universities for scientific research, the industrial world is and must continue to be entirely dependent upon them for the training of its technical personnel, and a part of the responsibility for seeing that such training is provided must in the future be accepted by the industries. Although the Sherman law forbids the formation of combinations in restraint of trade, there is, I believe, nothing in that act which forbids the formation of combinations within an industry for the purpose of uniting on a program for furthering research on fundamental problems and for aiding the universities of the country in the work of training the technical personnel required by the industry.

The afternoon sesssion was opened at 2.45 p.m. at the New Southern Hotel. Lantern and other arrangements were provided by the local section.

Twenty-three Types of Optical Glass

ROBERT J. MONTGOMERY, the author of this paper, said it was the first article within his knowledge that contained a general survey of the subject of optical glass as regards its technical classification. He continued:

By the word optical we mean those glasses which are selected for certain purposes because of their behavior toward transmitted light. This behavior is primarily due to the composition of the glass and not to its shape. Practically all of these glasses are silicates. There are a few special glasses containing no silica, as borates and phosphates, but they are of minor importance as far as quantity of glass manufactured is concerned. Each constituent has an effect on the index of refraction and the dispersion of the glass, and these two properties identify the glass as being of a certain type. Glasses not called optical glass are those made to meet some other requirement than that of index of refraction and dispersion. These will include ordinary soda-lime and lead glasses, in which the composition may be changed to obtain satisfactory melting qualities or in thermometer glass, where the coefficient of expansion is important. The main difficulty in making optical glass is in obtaining the required optical properties and at the same time so combining the constituents and handling the material that a good quality of glass will result.

A study of published information combined with our practical experience in the manufacture of optical glass brings out that: (1) All the glasses may be plotted on co-ordinate paper, allowing the dispersion to be represented by the horizontal distance and the index by the vertical distance; (2) that the glasses fall into natural groups in the field plotted and may be divided into types according to composition; (3) that there are 23 ordinary types of optical glass, each type embracing a number of glasses quite similar in optical properties, composition and method of manufacture; (4) that the composition of the glasses may be divided into two divisions: (*a*) Basic oxides affecting the optical properties, and (*b*) control chemicals which affect the melting behavior. The basic oxides are SiO_2, K_2O, Na_2O, CaO, BaO, PbO, ZnO, B_2O_3, etc., while by the control chemicals are meant the proportioning of carbonates, nitrates, chlorides and sulphates or the use of As_2O_3 and Sb_2O_3 to obtain good melting conditions.

The illustration shows the fields occupied by the various types of glass with an index 1.45 to 1.800 and dispersion value from 20.0 to 70.0. These are listed in Table I. The ones marked with a star are now being successfully made in commercial quantity in this country.

TABLE I.

1	Boro silicate crown	13	*Baryta light flint
2	*Boro silicate crown, high Nd	14	*Baryta flint
3	Crown of low Nd	15	Dense baryta flint
4	Light silicate crown	16	*Telescope flint
5	*Ordinary crown	17	Extra light flint
6	Telescope crown	18	Boro silicate flint
7	*Ordinary crown of low Nd	19	*Ordinary light flint
8	Soft silicate crown	20	*Ordinary flint
9	Zinco silicate crown	21	*Dense flint
10	Barium silicate crown	22	*Extra dense flint
11	*Dense barium crown	23	Densest silica flint
12	*Densest barium crown		

It will be noticed that we have now made in this country 12 out of the 23 ordinary types of optical glass. Most of those which have not yet been made have not been attempted because of lack of demand for the glass.

In making this survey of optical glasses only the general compositions are discussed. There is a natural field in which we normally use each constituent. This does not mean that such constituents may not be used outside of its natural field to control the optical properties or the quality of melting. The amount used in such cases is small and does not affect to any considerable extent the type of the glass. When it is desired to develop a new glass with new optical properties its composition can be roughly determined by interpolation between known points in the fields, and the necessary chemicals are definitely shown except in those cases where unusual materials are used. Special glasses not containing silica, as borates and phosphates, are not considered in this paper, and a few special ones within the field given are left out, as they do not bear directly upon the general subject.

Discussion

Dr. HOSTETTER.—Mr. Montgomery is quite right in stating that the band on the left of the chart should really be a line. We made a similar diagram some time ago and thought it would be absurd to give names to various types of glass, so attempted to describe each by its index number. Lens makers, however, are interested in *partial* dispersions, therefore the numerical symbol could not be used. We finally gave up, but decided something more definite in classification should be evolved.

Mr. MONTGOMERY.—I agree this classification is indefinite and a new one should be based on partial dispersion. The names we have given, however, are generally used and this chart, being only for *general* classification, is the best we have at present.

Dr. TURNER, secretary of the British Society, is called upon and while having nothing to say on the paper brings hearty greetings of his society. Appreciates welcome he has received in the United States and the work that is being done between the two societies. Wants to make arrangements for the joint meeting next year. Feeling the need for information on ceramics, the British Society has projected the publication of a series of pamphlets for the benefit of the industry.

Other Papers

Brick and Tile, DOUGLAS F. STEVENS.—I have been requested to speak as a representative of the Brick and Tile Division. This has been most recently organized

because if not done the work would have been buried by other activities of the Society. The Ceramic Society has done much and can do more for the brick and tile industry.

Directed toward chemical uses, it was originally used only for chemical stoneware, but we find now that the chemical plant puts it to all sorts of uses. More has been done in this connection than ever before during the last year. When the speaker visited the government plants at Sheffield, Ala., and saw the extensive use of ceramic ware and brick in the acid and ammonium nitrate plants he was glad to be in business. Here the most beautiful specimens of brick and tile work that he had ever seen in the construction of coolers, acid towers, tank linings, floors, flues and innumerable other places where proof against deterioration from acid and alkali solutions was necessary, were in evidence. This sort of work has been going on for four or five years and it is up to research parties to find new uses for brick and tile.

The value of fuel is steadily increasing. The ceramic industry consumes fuel in the greatest quantities of any except the steel industry. Much work needs to be done on more efficient use of fuels. The effects of alkalies and lime in driers and kilns must also be studied.

The brick and tile manufacturers are coming to appreciate the efforts of our society and we should secure more of them for membership. They are alive to its benefits, appreciate the work the universities are doing and will co-operate heartily with us in the activities of the future.

Artificial Silimanite, A. MALINOVZKY.—This paper contained a lengthy technical discussion of the method evolved by the author for producing artificial sillimanite, complete with chemical reactions, numerous lantern slides and a thorough explanation of the method of operation of the furnace. Analyses of resulting products showed progress of the reactions and microscopic views exhibited the lnong needle-like crystalline forms of the physical structure.

The Making of Pottery, FREDERICK H. RHEAD.—The most commonly known ceramic decorative processes are divided into ten broad groups. Each group is briefly reviewed with particular reference to typical examples ranging from the primitive or early works to modern productions. The processes of primitive, medieval and modern potters are discussed from a practical point of view. A description of various methods, tools and the physical condition of the materials is given, while the artistic and commercial developments are suggested by illustrations of examples referred to in the paper.

The groups enumerated are as follows:

First, incised and etched surface decorations, examples referred to: Early British, Chinese, Italian Sgraffito, Modern Porcelain, Cast Sgraffito, and commercial tile treatments.

Second, modeled and relief surface decorations. Examples referred to: Ancient Chinese, Roman, Eler's style, Palissy, German Stoneware, Wedgwood, Modern.

Third, slip processes. Examples referred to: Old English, Toft, European, Modern Slip Decorations, Pate-sur-pate.

Fourth, underglaze processes. Examples referred to: Grecian, Italian, Majolica, Chinese, Japanese, Modern European, commercial processes.

Fifth, glaze manipulation. Examples referred to: Chinese, Persian, European, Modern.

Sixth, plain glaze treatments. Examples referred to: Chinese, Modern.

Seventh, lustre processes. Examples referred to: Persian, Spanish, Modern.

Eighth, overglaze decorations. Examples referred to: Chinese, European, Modern.

Ninth, sculpture. Examples referred to: Chinese, Italian, European, Modern.

Tenth, architectural pottery. Examples referred to: Babylonian Bricks, Della Robbia, Mexican, European, American, Italian Mosaic.

Buy on Analysis, DR. ALEXANDER SILVERMAN.—This paper deals with the variations in composition of soda ash, pearl ash, limestone, quick lime, burnt lime, sand, litharge, niter, salt cake, zinc oxide, alumina, china clay, feldspar, fluerspar, cryolite and other minerals and chemicals used in the manufacture of glass. It illustrates the wide range of possibilities in composition and emphasizes the necessity for purchasing one kind of material for a given manufacturing purpose. The author points out that there is not so much danger in the difference of composition as in substituting a material of one composition for that of another formerly employed in glass making at a given factory without making necessary corrections. The paper further emphasizes the importance of the density of material such as soda ash and the mechanical analysis of sand calling attention to variations in grain size which might produce different results in glass manufacture.

The Manufacture of Optical Glass, DR. J. C. HOSTETTER. — In 1885-90 George Macbeth successfully started the manufacture of optical glass in the United States, but the industry was not really developed until the advent of Bausch & Lomb in 1912 and the Pittsburg Glass Co. and Spenser Lens Co. in 1914. With this somewhat restricted production as a basis, the industry received a tremendous impetus due to the requirements for a large tonnage in military uses.

It was necessary to produce large quantities of containers for melting the glass, and the Bureau of Standards and U. S. Geological Survey aided in obtaining the special clay needed. These crucibles are slowly constructed by hand and heated for seven days at a temperature of 1000 deg. C. They are then placed into the furnace for filling. The Armour Fertilizer Co. furnished a fine grade of potash containing only from ½ of 1 per cent chloride down to 0.0002-0.0003 per cent. The pots are used for one melt only. The heat is regulated through optical pyrometer readings.

Homogeneity is the main requirement in the manufacture, and the mass is constantly stirred by clay tubes both hand- and machine-operated. The stirring continues during the heat and at intervals while cooling. The mass is finally cooled and broken into large pieces, of which only the best are selected. The first rejection consists of about 80 per cent of the total, and 50 per cent of that is rejected on the second inspection. After many subsequent inspections the finest product is pressed into final form and shipped.

The United States probably doubled the production of the Jena output during the war period, starting from a negligible production at the outbreak

The Menace of the Postal-Zone Law

By Frank W. Mondell
Representative in Congress for Montana

I AM opposed to the zone system for the dissemination of news, ideas and information because I am of the opinion that the establishment and maintenance of such a policy would, in the long run, have a most unfortunate, harmful and regrettable effect upon the American people.

If we are to maintain peace, order and justice under the institutions of free government within our borders, we must have a homogeneous people guided by the same principles and inspired by the same ideals. This condition essential to the maintenance of free government can only be secured by the widest possible circulation of those instruments and instrumentalities which inform, mold and affect public opinion.

Any policy which tends to make us provincial or parochial as a people, which tends to build up zones of influence and information, is a policy not only harmful but one that long continued and widely extended would prove fatal to free institutions. On the other hand, a policy which makes equally available to the people in all parts of the country the journals and magazines which convey information, carry current argument, analysis and entertainment, tends to maintain those conditions essential to our institutions.

Those whose views or arguments for the zone system are based primarily or largely on its effect, or alleged effect, on postal revenues, or the profits of the publishing business, fail utterly to grasp or realize the larger and infinitely more important aspects of postal systems as they effect the national life. If it be a fact that the flat postal rate on newspapers and magazines has been unduly low, that is a matter for consideration by the Post Office Committee, having in view the traditional policy of the American people. The fact that some people have been able to make a considerable amount of money in the newspaper and magazine business is, of course, one of the matters that a committee would consider in this connection, but it is by no means conclusive that a policy is wrong because some people have been able to make money under it—many having the same opportunities and privileges failed utterly.

The demand for the establishment and maintenance of a zone system is particularly lame and illogical when it is made by those who are urging a flat rate of one cent on letters. Such people to be logical should insist upon a zone rate for letters as well as papers and periodicals. Neither is the argument for a zone system strengthened by exaggerated statements of losses to the postal revenues under a flat rate. Undoubtedly the former flat rate did not wholly reimburse the postal revenues, but the most superficial examination of the matter renders ridiculous exaggerated statements of alleged losses. To the argument that publications enjoying the second-class rates are devoted more or less to advertisement, I offer the suggestion that a national dissemination of attractive advertisements is not without its educational benefits.

I have neither urged nor considered this as a party question. I urged this repeal before the previous Democratic Congress, as I shall before the present Republican Congress—not on party or partisan grounds, but on the broad platform that such a policy tends to circumscribe and provincialize our national life to our great haven as a people.

Preparation of Fuller's Earth

By W. C. Phalen.

The bleaching action of fuller's earth is independent of its chemical composition, but depends entirely upon its selective power of absorption or capillary action. Therefore the slight variations in the analyses of the earth bear no relation to its bleaching powers. As is well known, the main use of fuller's earth is for the bleaching of petroleum oils, and the gravity method is used in preference to agitation. The main object sought is to get the lightest possible color with the most prolonged use of the earth, the renewal of which is accomplished by burning.

In a recent article by C. R. Siegfried (*National Petroleum News*, Aug. 20, 1919, p. 38) it is pointed out that the blame for poor filtering is often placed on the earth, whereas it is due to improper manipulation. It is important to bear the following factors in mind: (1) The longer the column of earth, the better the bleach and the lighter the color of the oil, other conditions being equal. (2) The coarser the earth, the more rapid the flow and the poorer the bleach, other conditions being equal. (3) The higher the temperature, the faster the flow and the poorer the bleach, other conditions being equal. (4) As a corollary, filtration should take place at the lowest temperature at which the oil works well. (5) The oil which is being filtered must be fluid enough to be acted on mechanically by the internal structure or pores of the earth, for it is in these pores that the coloring ingredients of the oil are retained, and not in the spaces between the grains themselves. Each particle of the earth, therefore, has its own work to do independent of the others.

The preparation of the earth prior to its going to the filtration plant is of great importance. It follows that the workman firing a burner for fuller's earth is the party who breaks or makes the life of the earth in the filter. The preparation is done by burning and the first burning is the most important of all.

All fuller's earth is hygroscopic, that is, it absorbs moisture from the air. During the first burning it is essential to get rid of this absorbed moisture and also the chemically combined water. The quantity of water varies from 10 to 15 per cent, and this must be expelled before the earth goes to the filter. Organic and volatile salts are also expelled during the first burning, and calcium carbonate is converted to caustic lime.

It has been found by experiment that the best temperature for the initial burn is 600 to 700 deg. F. At this temperature all moisture is expelled and there is no danger of fusion or incipient fusion, whereby the particles are glazed, the pores closed and the absorptive power lost.

The second burning is almost as important as the first, as there is a greater tendency for the grains to fuse and stick together than in any subsequent burnings. It is, therefore, run more slowly than the first or subsequent burnings, and at a temperature of 1050 to 1100 deg. F. In subsequent burns with Florida earth, the proper temperature has been found to vary from 1100 to 1200 deg. F. Any temperature above 1200 deg. causes a loss of filtering power. It was found on the fourth burning of two samples of earth from the same filter that of two samples—the one burned at 1100 deg. F. and the other at 1400 deg. F.—the overburn of 300 deg. F. caused a loss of filtering power of 30 per cent.

Synopsis of Recent Chemical and Metallurgical Literature

Some World-Wide Problems of the Chemical Industries.—Dr. H. GROSSMANN gives in the Dec. 4, 1918, issue of *Technische Rundschau* a review of some of the world-wide problems of the chemical industry. He states:

The obtaining of sufficient quantities of food is intimately dependent on the manufacture of great quantities of artificial fertilizers. This can be attained only by working with all available forces on the problem of supplying European and American farmers with potash salts, phosphates, and nitrogenous fertilizers. The large and productive potash deposits of north Germany assure the Germans of a sufficient supply of these for the present and the future. These must be regarded as the cheapest of all artificial fertilizers.

Still greater achievements have been made during the war in the production of nitrogenous fertilizers. It is now generally known that without the great successes of present science and technology in the manufacture of artificial saltpeter, synthetic ammonia and calcium cyanamide, the great war would have been lost by Germany within a few months of its beginning. England, France and recently even the United States took up energetically the same questions, in all cases the governments actively supporting these industries. In the next few years we can even count on an oversupply of these nitrogenous fertilizers, as a result of this great activity during the war.

The manufacture of calcium cyanamide in such large quantities gave rise to a greatly increased production of calcium carbide and it is in place to consider whether this latter fact may not lead to the manufacture from it of alcohol and acetic acid cheaply and in large quantities. Such industries may attain great importance in countries having large cheap water powers, such as Switzerland and Scandinavia.

Another important world problem is the more rational and efficient utilization of our fuels. We must particularly produce liquid hydrocarbons, which will replace petroleum and its derivatives, such as benzine, motor oils, lubricating oils and paraffine. On the basis of what was accomplished in Germany during the war in the way of using bituminous and brown coals so as to obtain from them products similar to those mentioned, we may predict that further advances in this direction are sure to be made. Even as it stands at present, Germany is assured a greatly increased supply of benzol from these domestic fuel plants, while great quantities of tar and tar oils, fuel oils and motor oils are also made by the same processes. These tar oils were highly useful during the war in taking the place of lubricating oil from petroleum, and thus they were in a position to keep their large gas machines and motors in operation.

Great hopes are likewise being based on the low temperature distillation of bituminous and brown coal in gas producers, producing new varieties of tar which are good for lubricating and internal combustion motors. This is a very promising field, which has been actively followed up by several German firms and institutes of research.

The technical use of hydrogen gas under pressure appears also to be particularly valuable, such as in the Bergin process of the Consortium for the Chemistry of Carbon and in the tetraline process of the Tetralin G. m. b. H. of Dessau. Tetraline, or tetra hydronaphthalene, is a very useful material, as in the lacquer industry. It has become possible to thus convert solid naphthalene into a fluid hydrocarbon with numerous new applications.

England and America have certainly begun during the war similar developments in carbon chemistry and the utilization of fuels, and it cannot be doubted that this fact alone would make it absolutely necessary for Germany to pay the greatest attention to the progress of science and technology in foreign countries. The former German Minister of Education, von Trott zu Zolz, was therefore quite right when he said, as far back as January, 1917, in his report on the furthering of foreign study, that a greatly increased knowledge of what foreign nations were doing was an absolute necessity. From the present standpoint, such a continuous and close study of foreign methods appears more necessary than ever.

In the present difficult times none of us should grow pessimistic or lose courage for his work; we should see that in the near future our spiritual and material development is going to continue. This is particularly true of the chemical industry of Germany, which before the war was recognized by all the world as pre-eminent. This being so, we should recall the very true words printed by the *North American Review* in 1893, which are well worth quoting in concluding these remarks:

"That country which has the best chemists will eventually become the richest and most powerful. It will possess at the lowest prices the best food, the best manufactures, the best weapons, and lose the least in production. Its people will make the best possible use of the natural resources of their land, because of universal hygiene they will enjoy the best health, and they will be least dependent on other nations for supplying their needs. The instruction of the people in chemistry and other natural sciences is therefore to be regarded as the best investment of a people's capital, since in the future the competition for place among the nations will depend principally on their achievements in scientific and technical chemistry."

The Increased Value of the Taylor System for Post-War Times.—The Jan. 1, 1919, issue of the *Technische Rundschau* contains an interesting article by ENG. WINTERMEYER on the application of the Taylor system for post-war times, with special reference to Germany. He remarks:

The quick and successful application of this system to American industries has given them a great advantage in international competition. To catch up to the Americans in this field, and if possible to surpass them, should be the aim of all who are active in industry and trade.

For reaching the lowest cost of production, it is necessary to divide up the work into as many different parts as possible. Each workman thus becomes highly skilled in a very small field, and gives his whole attention to perfecting it; in other words, he becomes a specialist, with great knowledge and ability in a narrow field. Each workman must be assigned to that particular part of the field for which he has the greatest inclination and aptitude. He must be contented and take

pleasure in his work; only thus can the best ends be attained. A skilled workman should never be assigned a task which a less skilled or ordinary laborer can do. The average workman must be relieved as far as possible from unnecessary mental work; this should be done for him by others who are better prepared for it by inclination and education. The scheme therefore involves a fundamental study of each worker to determine his aptitudes and capabilities.

The mental work must be done outside of the workshop, in a particular bureau where a corps of educated men are placed. These do the preliminary researches and calculations leading up to the mechanical work; they are also specialists, giving in each field the best possible service. They are always in close touch with the workman, and when they bring the workmen under their care forward satisfactorily, they are correspondingly rewarded. They therefore work hand-in-hand with the workmen.

In each division of the work, the workmen must be taught to practice simplification and improvement of their particular part. Each working motion must be studied to see if it cannot be done in a simpler and more effective way. Every unnecessary, purposeless movement or action is to be cut out, leaving only the absolutely necessary working motions which can attain the desired end.

A very important part of the system is the standardization of parts. The greatest care is given to selecting the most readily producible parts which go into the construction of a complex article. The question is how far standardized parts can be thus used. If, for instance, a certain system of screws is standardized, then the constructor must endeavor to use these normal forms wherever possible, thus saving time, money and attention. This does not limit the free activities of the designing engineer; the opposite is the case. How important this idea is, is well shown by the recent creation of the Standardization Committee of German Industries.

In actual application of the Taylor system it is absolutely necessary that the individual workman be fully contented; only so can the best results be attained. This is attained most completely on the basis of the manner and amount of payment for work done. This is done absolutely fairly and impartially. A single foreman does not determine the wages, but this is done by the "works bureau," on the basis of their own experiments and experience. This bureau makes most complete investigations of the time necessary to perform the individual movements or operations of which the work consists. These studies form the basis of the time assigned to each piece of work. Adding to this necessary time a certain percentage for rest or relaxation, there results the average time which should be allowed for the operation. The percentage assigned for relaxation must also be studied, and assigned such an amount that the workman can work through his shift without becoming sleepy or exhausted.

The workman who reaches the output thus determined is given high wages; if he exceeds it, still higher, if he comes short, below a certain standard, he is paid accordingly. Whether he reaches the high standard or not depends on his industry and skill. The average workman can produce much more working under the Taylor system, and this improvement is made profitable both to himself and to the employer.

Recent Chemical and Metallurgical Patents

British Patents

Complete specifications of any British patents may be obtained by remitting 25c. each to the Superintendent British Patent office, Southampton Buildings, Chancery Lane, London, England.

High-Speed Tool Steel and Other Steel Alloys.—High-speed tool steels and other alloy steels containing chromium, vanadium, tungsten, titanium, or the like are made by a single aluminothermic reaction of a charge containing aluminum, magnesium, silicon, or like reducing elements, and ores, oxides, or salts of chromium, etc., iron, and carbon, without the use of a separately prepared bath of molten iron or steel. The carbon may be present as ferrochromium or other alloy, and some high-speed or like steel scrap may be used. For example a steel alloy containing carbon, cobalt, chromium, vanadium, tungsten, and manganese may be prepared from a charge containing separately prepared aluminothermic iron, tungsten and cobalt mixtures, wrought iron or mild steel, carbon-free ferrovanadium, and ferrochromium containing about 8 per cent of carbon. (British Patent 123,102—1918. W. L. TURNER, Purley Chase, Atherstone, Warwickshire. April 9, 1919.)

Extracting Metals and Alloys.—Aluminum alloys containing zinc, copper, iron or other metals and 65 to 97 per cent of aluminum, with or without small amounts of magnesium, silicon, calcium, or the like, are used instead of commercially pure aluminum in thermo-aluminic mixtures for use in the manufacture of metals and alloys, or in the production of steel alloys by the process described in Specification 123,102—1918. The aluminum alloys may be melted, cast and crushed. In some cases, part of the aluminum alloy in the mixture may be replaced by pure aluminum, magnesium, silicon, or the like. In using the mixture, the parts of the charge near the points of initiation of the reaction may be more finely divided than the remainder. (British Patent 123,103—1918 W. L. TURNER, Purley Chase, Atherstone, Warwickshire, and H. A. BLACKWELL, Whyte House, Bispham, Blackpool. April 9, 1919.)

High-Speed Tool Steel and Other Steel Alloys.—High-speed tool steel hammerscale is used as an ingredient of the thermo-aluminic mixture for making high-speed tool steel, magnet steel, or other steels containing tungsten, chromium, vanadium, titanium, cobalt, molybdenum, and the like, according to the process described in Specification 123,102—1918. For example, a mixture may be used containing 100 lb. of the scale, 4½ lb. of ferrochromium containing about 60 per cent of chromium and 8 to 10 per cent of carbon, 10 lb. of wrought iron or mild steel, and 28¼ lb. of aluminum. Silicon and manganese, if required in the steel, are added as ferrosilicon and ferromanganese preferably after the thermo-aluminic reaction. (British Patent 123,113—1918. W. L. TURNER, Purley Chase, Atherstone, Warwickshire. April 9, 1919.)

Chrome Steel.—A mild chrome steel containing 12 to 15 per cent chromium and less than 0.1 per cent of carbon, or a rustless chrome steel containing 0.2 to 0.4 per cent of carbon, is produced as described

...n Specification 123,102—1918, by the thermo-aluminic reaction of a mixture of chrome iron ore or other chromium and iron bearing materials and aluminum, magnesium, silicon, or the like, or scrap aluminum alloy (say 30 per cent aluminum), the mixture containing also, in some cases, some metallic iron and in the case of the second mentioned steel, sufficient carbon. (British Patent 123,104—1918. W. L. TURNER, Purley Chase, Atherstone, Warwickshire. April 9, 1919.)

Ferrochromium.—In the production of carbon-free ferrochromium by the alumino-thermic process, potassium or sodium bichromate or chromate is added to the mixture of chrome iron ore and aluminum or other reducing agent. The mixture may be preheated. (See British Patent 123,104—1918.) (British Patent 123,105—1918. W. L. TURNER, Purley Chase, Atherstone, Warwickshire. April 9, 1919.)

Acetates.—Aqueous solutions of acetic acid are extracted by organic solvents insoluble in water (ex. benzene or toluene) and the extract is neutralized by a solution of basic lead acetate, milk of lime, or alkalis. The solvent is separated from the neutralized solution and used again for extracting the acetic acid solution. The process may be applied to the dilute sodium acetate liquors resulting from the manufacture of chrome yellows from lead acetate; the sodium acetate liquor is acidified with sulphuric acid and extracted with benzene, which is repeatedly circulated between the acid solution and a solution of basic acetate of lead or milk of lime. (British Patent 122,953—1918. E. F. MORRIS, Holly Bank, Roby, near Liverpool. April 9, 1919.)

Obtaining Lead Electrolytically.—Spongy lead, suitable for use in making battery plates, is obtained by electrolyzing a caustic alkali solution with an anode of lead or lead peroxide, for instance an old battery plate, and a cathode of another metal such as zinc and collecting the metal floating at the surface of the electrolyte. The electrolyte may contain 20 per cent of caustic potash. A suitable current density at the anode is 12 amp. per sq.ft. The product is impregnated with hydrogen from the cathode, and may be freed therefrom by compression if desired. It is washed successively in acid and water. (British Patent 123,587—1918. V. G. JOURIEFF, 43 Victoria Road, Chingford, Essex. April 24, 1919.)

Obtaining Metals and Alloys Electrolytically.—In the production of metals and alloys, such as tin, copper and bronze, in the form of paste or sludge, suitable for coating paper, anodes formed partly of the metal and partly of insoluble material such as hard graphite are used to prevent an increase in the quantity of metal in solution. The ratio of the areas of the soluble and insoluble parts of the anode may be adjusted by raising or lowering them. Further regulation may be obtained by immersing in the electrolyte at intervals pieces of the metal, not connected in circuit. The electrolyte may be circulated through a series of vats, the soluble or insoluble anodes being in the same or different vats. Means for regulating the electric current or liquid flow through individual vats may be provided. A heating or cooling coil may be arranged in the liquid path. In the production of tin, the electrolyte may contain 2.5 g. of tin and 50 g. hydrochloric acid per liter; the cathode current density may be 60 amp. per sq.dm.; the ratio of the area of the soluble anode to that of the insoluble anode may be 2 : 4, and the temperature not above 28 deg. C. —say 20-21 deg. C. (British Patent 124,006—1918. B. LEECH, 77 Powell St., Macclesfield, Cheshire, and H. & L. SLATER, Harter St., Manchester. May 7, 1919.)

Phenolaldehyde Condensation Products.—In the production of resinous condensation products from phenols and aldehydes, ammonium salts of volatile organic acids (formic, acetic, propionic, butyric, valeric, etc.), ammonium salts of organic acids which decompose to phenols or cresols, salicylic acid or ammonium bicarbonate are used as condensing agents. The process is carried out by heating the reagents until the condensation product has formed, removing the upper aqueous layer from the product, allowing the residue to stand, and cooling to separate more water, and to drive off all the water. Lime, baryta or magnesia may be added in the last stage to assist in removing the condensing agent. Fatty acids or their salts, resins, gums, waxes, rubber, etc., may be incorporated in the product. (British Patent 124,01... —1918. R. E. DIOR, 93 rue Thiers, Boulogne sur Seine, France. May 7, 1919.)

Preparation of Aluminum Chloride and Sodium-Aluminum Chloride.—Calcined clay and sodium or potassium chloride are heated in a rotary furnace to bright redness and vapors of arsenious oxide are passed over, to form sodium or potassium aluminate, silica, aud vapors of arsenic trichloride. The aluminate is separated by solution in water, and carbon dioxide is passed through the solution, forming sodium or potassium carbonate, and precipitating alumina. The alumina is mixed with coke and in some cases sodium chloride, and formed into briquettes, which are heated and treated with gases containing chlorine formed from the arsenic trichloride. Aluminum chloride or the double salt sodium-aluminum chloride is formed and distilled. The flue gases containing vapors of arsenic trichloride formed in the first operation are treated with steam to form arsenious oxide, which is condensed by cooling, and hydrochloric acid gas, which is oxidized to yield chlorine by admixture with air and passage over heated catalytic surfaces such as small balls of clay impregnated with copper chloride. The gases containing chlorine are washed with water to remove hydrochloric acid and are dried. (British Patent 123,243—1918. E. E. DUTT and P. C. DUTT, Jubbulpore, Central Provinces, India. April 16, 1919.)

Continuous Zinc Extraction.—The zinciferous ore is mixed with bituminous coal, the mixture subjected to a low-temperature coking, out of contact with air, expelling thereby the superfluous hydrocarbons and water vapors. The mass is powdered and fed at the top of a retort comprising 3 sections. The smelting takes place in the middle section of the retort. The zinc vapors pass out through a branch in the upper section to a condenser in which a hood floats in the metallic zinc and protects it and the fumes from oxidation. The residue from the middle section, which will contain in the metallic form any lead or iron originally present in the ore, etc., passes into the third (lower) section of the retort, from which it may be discharged periodically or continuously, admission of air to the retort being prevented. (British Patent 122,688—1918. J. ARMSTRONG, 5 Victoria St., London, April 2, 1919.)

Publications in Europe and Africa.

A list of newspapers, trade journals and other publications in the principal cities of Europe and Africa has been prepared, from names submitted by American consular officers and representatives of the Bureau, for the benefit of firms interested in foreign advertising. This list may be obtained from the Bureau of Foreign and Domestic Commerce or its district and cooperative offices by referring to file No. 9858.

The Gold Production of Australia.

The gold production of Western Australia continues to show a steady decline. During the six months ended June 30, 1919, the total Australian production amounted to 573,279 fine ounces, of which Western Australia furnished 410,428 oz. For the first six months of 1918 the Australian production was 641,911 oz., the State of Western Australia furnishing 443,983 oz. During the first six months of 1917 the total production amounted to 727,995 oz., of which amount Western Australia furnished 490,466 oz.

It is stated that the cause of this decline is increased working expenses due to high wages and the high cost of machinery and materials. It is not expected that much, if any, improvement can be looked for in the immediate future.

The Chemical Warfare Service.

Senator Chamberlain in his criticism of the Army reorganization bill comments as follows on its failure to continue the Chemical Warfare Service as a separate entity:

"No provision is made in the pending bill for the maintenance of that important service as developed and organized during the recent war, but it is understood that it is the purpose of the Secretary of War to assign it permanently to the Engineer Corps, under the general powers proposed to be conferred upon the President by this bill.

"In consideration of this subject it is of the first importance to bear in mind that such a service must have two separate and distinct functions. One of them is scientific research and the development, production and procurement of necessary materials. The other function is the application of those materials by appropriate troops to military uses, just as the materials developed, produced and procured by the Ordnance Department are applied to military uses.

"These two functions of a Chemical Warfare Service should not be combined in one organization or under one head, because there are no officers in the Engineer Corps or elsewhere in the Army whose training and practical experience as chemists fit them either for the performance or the intelligent supervision of the scientific duties of chemical research and production.

"There should be established in the Army a department of chemistry, along the lines of the Medical and Ordnance Departments, to be filled from top to bottom with expert professional chemists.

"To this department should be assigned all duties pertaining to the scientific research required, and to the development, production and procurement of all materials needed for the purposes of chemical warfare, such materials to be supplied to appropriate troops for application to military uses, including the making of the necessary experiments with regard to such uses.

"To this department should also be transferred, as far as practicable, all work of a chemical nature now done in or under the various bureaus of the War Department."

Personal

Dr. JEROME ALEXANDER, well known for his contributions on colloid chemistry, is confined to his house in the country at Ridgefield, Conn., by illness. The latest reports concerning his condition are favorable.

Lieut. C. H. HAZARD, recently discharged from the Chemical Warfare Service, is now with H. A. Metz & Co., Inc., and the Consolidated Color & Chemical Co., in its purchasing department.

Lieut-Col. ELMER K. HILES, formerly of the Engineers, A.E.F., is now manager of laboratories, Pittsburgh Testing Laboratory, Pittsburgh, Pa.

Mr. JACK J. HINMAN, JR., formerly captain in the Sanitary Corps of the A.E.F., has returned to his pre-war duties as water bacteriologist and chemist to the Iowa State Board of Health and assistant professor of epidemiology in the State University of Iowa.

Mr. JULIUS B. KOHN, formerly employed by the U. S. Public Health Service as organic chemist, doing research work under the direction of Dr. Julius Stieglitz of the University of Chicago, is now connected with the Mallinckrodt Chemical Works, St. Louis, Mo., as research chemist.

Professor GILBERT N. LEWIS, dean of the College of Chemistry, University of California, formerly lieutenant-colonel in the Gas Service, A.E.F., has been decorated Chevalier of the French Legion d'honneur.

Mr. VICTOR E. NELSON, associate in chemistry, Johns Hopkins University, has accepted a position as assistant professor in charge of physiological chemistry at the Iowa State College.

Professor J. E. PETAVEL has been appointed director of the British National Physical Laboratory in succession to Sir Richard Glazebrook, retired. Professor Petavel is professor of engineering and director of the Whitworth Laboratory in the University of Manchester.

Mr. L. E. SAUNDERS, manager of research and abrasives plants, Norton Co., has been transferred to the main executive office at Worcester, Mass. Mr. P. G. SAVAGE becomes assistant to Mr. Saunders as resident manager of the plant at Niagara Falls, N. Y., and Chippawa, Ont., Canada.

Professor NORMAN A. SHEPARD, Yale University, New Haven, Conn., has resigned to enter the employ of the Firestone Tire & Rubber Co.

MR. JEROME STRAUSS, formerly first lieutenant, Inspection Division, Ordnance Department, is now assistant chemist and metallurgist, U. S. Naval Gun Factory, Washington, D. C.

Current Market Reports

The Non-Ferrous Metal Market

Monday, Oct. 6.—Little activity is to be found in the non-ferrous metal market, but prices are firm and producers willing to carry stocks.

Copper sheets, hot rolled		33½
Copper sheets, cold rolled		35
Copper bottoms		41½
Copper rods		24¾
Copper wire		26
High brass wire & sheets		27¼
High brass rods		26¾
Low brass wire & sheets		30½
Low brass rods		31¾
Brazed brass tubing		39
Brazed bronze tubing		44¼
Seamless copper tubing		37½
Seamless bronze tubing		44¼
Seamless brass tubing		36
Scrap, heavy mach. comp.	17	— 18
Scrap, heavy and wire	17	— 18
Scrap, light and bottoms	15	— 16
Scrap, heavy, cut and crucible	19	— 20
Scrap brass, heavy	10¾	— 10¾
Scrap brass, casting	11½	— 12
Scrap brass, light	9¾	— 10
Scrap, No 1 clean brass turnings	9¾	— 11
Scrap, No. 1 comp. turnings	15¾	— 16

Aluminum:—**The market remains quiet, small sales of 98-99 per cent ingots continue at 33c. per lb. Cast scrap is selling at 21¾-24¾c.; sheet, 21-23¾c.; clippings 23¾-27¾c.**

Antimony:—Silver fluctuations are expected to have influence on the Asiatic markets. A spot lot of 50,000 lb. is reported sold at 8c.; small job lots bring 8¼c.

Copper:—No transactions of importance are reported in copper at the present price of 23½c.

Lead:—There is a steady but small trade in lead at 6¼c. lb. in New York and 6c., East St. Louis. Sheet lead cuts are quoted at 9c. lb. Scrap lead, 5½c. lb.

Tin:—London market is rising. Straits spots are quoted at 55¾c and electrolytic at 54¾c. lb. in New York.

Zinc:—Prices are advancing in East St. Louis. Spot New York is now 7.60c. and St. Louis, 7.25c. lb. Scrap zinc, 5½c lb.

OTHER METALS

Bismuth	lb.	—	$2.95
Cobalt	lb.	2.50 —	3.50
Cadmium	lb.	1.50 —	1.75
Magnesium	lb.	1.75 —	2.10
Mercury	75 lb.		100.00
Nickel	lb.	.41 —	.45
Iridium	oz.		175.00
Palladium	oz.	115.00 —	120.00
Platinum	oz.	110.00 —	115.00
Silver	oz.		1.20⅛

The Iron and Steel Market

By reason of the strike, interest in the iron and steel market centers chiefly upon matters of requirements and supplies, for actual transactions are of small volume. The merchant furnaces are sold far ahead on pig iron, and the steel mills far ahead on finished steel products. Regular consumers are thus covered, subject to uncertainties of delivery on account of the strike, and have no particular occasion to make fresh purchases, while occasional or chance buyers cannot, as a rule, place orders.

The iron and steel strike began Monday, Sept. 22, and in three days had reached practically its height. Plants or districts that were largely affected at the outset went down completely, while those in which the strike did not get a good start succeeded in operating, and generally with gains in employment, so that after a few days more there was a clear cut division. Plants were either closed entirely or were operating practically normal. After the first few days the strike was spreading nowhere, but employment was spreading here and there, so that the strike was losing ground.

The gains in employment have been consolidated, and at the end of two weeks of strike the situation is that the East and South are operating practically full, western Pennsylvania is operating practically full, while Cleveland and the Mahoning Valley are down entirely, as is very nearly the whole of the Wheeling district. The next important development will be resumption in the closed regions. That may come soon or may be long deferred. The foregoing summary omits reference to some points or districts developments in which would not be crucial. Cambria at Johnstown, Lackawanna at Buffalo and Colorado Fuel & Iron at Pueblo are down entirely, while the Calumet district is operating at less than one-half and with great difficulty at that.

Pig Iron

Not because they are blast-furnaces, but because in large part they are more or less isolated, the merchant furnaces have been less affected by strike than the steel industry proper. Iron foundries are running as usual, while some steel works are not taking the merchant iron they usually take, and thus on the whole there seems to be an approximate balance whereby the strike does not make merchant pig iron either more plentiful or less plentiful.

Steel Products

The production of finished steel is at not more than about 60 per cent of normal. Even were the curtailment uniform in the various finished steel products, the influence as to producing a scarcity would not be uniform, because industries are in much more urgent need of some products than of others. A review will be undertaken as to supplies and requirements in a number of the finished products.

The case of plates stands by itself, for before the strike there was a large surplus of plate-rolling capacity, due to there being rather an eager demand while plate capacity had been increased very greatly during the war. The eastern Pennsylvania plate mills continued to run with scarcely any curtailment, but from Cambria at Johnstown and Lackawanna at Buffalo westward there was almost complete closing of plate mills except for Homestead and a few small plants, even Jones & Laughlin being considerably affected. The result is that plates are now a trifle scarce.

At the other extreme is the case of oil country goods, involving practically the output of the lap weld departments of the pipe mills. The strike is geographical and it chances that four important independents, easily the bulk of the independent production, are closed, Republic and Youngstown Sheet & Tube at Youngstown, La Belle at Steubenville and Wheeling Steel & Iron in the Wheeling district. The National Tube Co., on the other hand, is but little affected. It lost its Riverside plant in the Wheeling district, of course, but little else. Its largest plant, McKeesport, ran fairly well, and its next largest, Lorain, was unaffected, although only a few miles from Cleveland, where everything went down. Of two smaller plants in Pittsburgh, Continental stayed in operation and Pennsylvania went down for a few days, afterward beginning to recover. Altogether, the production of pipe was curtailed by 50 per cent at the lowest estimate, yet before the strike there was an acute scarcity of oil country goods, so much so that many lessees in the Texas field were almost certain to lose their leases through being unable to drill wells within the time they had injudiciously set.

The strike was proposed as if it were to be primarily a strike against the United States Steel Corporation, yet it has just been indicated that in pipe the independents experienced more strike than the Steel Corporation. The same was true in the case of sheets, yet the divergence in each case is due chiefly to geography. The fact is, of course, that the agitators simply aimed to produce all the strike they could, their plans succeeding in some places and not in others. After ten days of the strike the American Sheet & Tin Plate Co. was operating 72 per cent of its sheet mills, while not more than 50 per cent of the independent sheet mills were operating. Of the Steel Corporation sheet plants, seven were operating in full. The Steel Corporation sheet plants chanced to be widely distributed, many being in towns where there were no other plants. The independent sheet industry is centered largely in the Mahoning Valley, which next to Wheeling is traditionally the worst strike district in the industry. Sheet mills making specialties were not closed in altogether as great proportion as mills making common sheets, and thus makers of automobiles, metal furniture, etc., are in line to be incommoded somewhat less than users of common sheets.

Much more than half of both the Steel Corporation and the independent tin plate mills were closed by the strike. While as a rule skilled workmen had little to do with the steel strike except through being thrown out of employment by the common labor striking, in the case of tin mills there was no small amount of striking by tonnage men. The curtailment in tin plate production is of very small moment when contrasted with conditions in other finished steel products, the canning season being over. In normal years tin plate production is lighter at this season than at any other in the year.

Production of plain wire and wire products is greatly curtailed in the case of both Steel Corporation and independents, but the fall distribution to jobbers had been completed and the pressure for mill deliveries at this time of year is not heavy. Jobbers' stocks were relatively light. The mills operating, however, should keep the country moderately well supplied even should the strike in general be prolonged for several weeks.

Prices

There are many steel producers who are prone to seize upon every argument that may be marshaled in favor of advancing prices. That is not so much because steel producers are always wanting to make more money as because it has been a sort of custom in past years to run the market by advancing prices and thus encourage buyers to make contracts. At the present time there is no talk of advancing prices, not simply because the market is not being discussed, but because it is recognized that it would be bad form in the circumstances. Producers note with interest Judge Gary's remark before the Senate committee investigating the steel strike that prices are high enough already and it would be better for prices generally to come down.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, OCT. 8, 1919

		Carlots	Less Carlots
Acetic anhydride	lb.	—	$0.55 – $0.60
Acetone	lb.	$0.13½ – 0.14	.15 – .15½
Acid, acetic, 28 per cent	cwt.	2.50 – 3.00	3.00 – 3.25
Acetic, 56 per cent	cwt.	5.00 – 5.50	6.00 – 6.50
Acetic, glacial, 99½ per cent, carboys	cwt.	12.00 – 12.50	12.90 – 13.50
Boric, crystals	lb.	.13 – .13½	.13½ – .14
Boric, powder	lb.	.13 – .13½	.13½ – .14
Hydrochloric, (muriatic) tech. 20 deg.	cwt.	1.50 – 1.75	2.00 – 2.50
Hydrofluoric, 52 deg.	lb.	.12 –	.14 –
Lactic, 44 per cent. tech.	lb.	.11 – .14	.12 – .16
Lactic, 22 per cent. tech.	lb.	.05 – .06	.05½ – .07
Molybdic, C. P.	lb.	—	4.00 – 4.25
Nitric, 40 deg.	lb.	.06 – .06½	.07 – .08½
Nitric, 42 deg.	lb.	.07 – .07½	.08 –
Oxalic, crystals	lb.	.23 – .25	.25 – .30
Phosphoric, Ortho, 50 per cent. solution	lb.	.09 –	.10 – .14
Picric	lb.	.30 – .35	.40 – .50
Pyrogallic, resublimed	lb.	—	2.30 – 2.60
Sulphuric, 60 deg., tank cars	ton	12.00 – 16.00	—
Sulphuric, 60 deg., drums	ton	17.00 –	22.00 –
Sulphuric, 60 deg., carboys	ton	20.00 –	25.00 –
Sulphuric, 66 deg., tank cars	ton	17.00 – 18.00	22.00 – 23.00
Sulphuric, 66 deg., drums	ton	20.00 – 21.00	25.00 – 26.00
Sulphuric, 66 deg., carboys	ton	25.00 –	30.00 – 40.00
Sulphuric, fuming, 20 per cent. (oleum) tank cars	ton	20.00 –	27.00 –
Sulphuric, fuming, 20 per cent. (oleum) drums	ton	25.00 –	32.00 –
Sulphuric, fuming, 20 per cent. (oleum) carboys	ton	30.00 –	35.00 –
Tannic, U. S. P.	lb.	—	1.35 – 1.45
Tannic (tech.)	lb.	—	.42 – .55
Tartaric, crystals	lb.	—	.74 – .77
Tungstic, per lb. of WO	lb.	—	1.20 – 1.40
Alcohol, Ethyl	gal.	4.80 –	4.95 –
Alcohol, Methyl	gal.	1.30 –	1.33 – 1.38
Alcohol, denatured, 188 proof	gal.	.56 –	.58 – .60
Alcohol, denatured, 190 proof	gal.	.52 –	.54 – .56
Alum, ammonia lump	lb.	.03½ – .04½	.04½ – .04½
Alum, potash lump	lb.	.08 – .08½	.09 – .09½
Alum, chrome lump	lb.	.15 – .16	.18 – .20
Aluminum sulphate, commercial	lb.	.01½ – .02	.02½ – .02½
Aluminum sulphate, iron free	lb.	.02½ – .03	.03½ – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.08 –	.08½ – .08½
Ammonia, anhydrous, cylinders (100-150 lb.)	lb.	—	.30 – .35
Ammonium carbonate, powder	lb.	.13 – .13½	.14 – .14½
Ammonium chloride, granular (white salammoniac)	lb.	.12½ – .13	.13½ – .14
Ammonium chloride, granular (gray salammoniac)	lb.	.12 – .12½	.13 – .13½
Ammonium nitrate	lb.	.10 –	.11 – .12
Ammonium sulphate	lb.	.05 –	.06 –
Amyl acetate	gal.	—	3.75 – 4.00
Arsenic, oxide, lumps (white arsenic)	lb.	—	.09 – .09½
Arsenic, sulphide, powdered (red arsenic)	lb.	—	—
Barium chloride	ton	85.00 –	90.00 – 100.00
Barium dioxide (peroxide)	lb.	.22 –	.24 –
Barium nitrate	lb.	.10 – .10½	.11 – .12
Barium sulphate (precip.) (blanc fixe)	lb.	.03 – .03½	.03½ – .04
Bleaching powder (see calcium hypochlorite)		—	—
Blue Vitriol (see copper sulphate)		—	—
Borax (see sodium borate)		—	—
Brimstone (see sulphur, roll)		—	—
Bromine	lb.	—	.65 – .75
Calcium acetate	cwt.	2.00 – 2.05	2.10 –
Calcium carbide	lb.	—	.04 – .05
Calcium chloride, fused, lump	ton	19.00 – 25.00	30.00 – 40.00
Calcium chloride, granulated	lb.	.01½ – .01½	.02 – .02½
Calcium hypochlorite (bleaching powder)	cwt.	2.25 – 2.50	– 2.75
Calcium peroxide	lb.	—	1.50 – 1.70
Calcium phosphate, monobasic	lb.	—	.75 –
Calcium sulphate, precipitated	lb.	—	.09 – .09½
Carbon bisulphide	lb.	.05½ –	.06 –
Carbon tetrachloride, drums	lb.	.10 – .11	.12 – .14
Carbonyl chloride (phosgene)	lb.	—	.75 –
Caustic potash (see potassium hydroxide)		—	—
Caustic soda (see sodium hydroxide)		—	—
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.08 –
Cobalt oxide	lb.	—	1.50 – 1.75
Copperas (see iron sulphate)		—	—
Copper carbonate, green precipitate	lb.	—	.28 – .31
Copper cyanide	lb.	—	.65 – .70
Copper sulphate, crystals	lb.	.08½ – .08½	.09 – .09½
Cream of tartar (see potassium bitartrate)		—	—
Epsom salt (see magnesium sulphate)		—	—
Formaldehyde, 40 per cent	lb.	—	.22½ – .24
Glauber's salt (see sodium sulphate)		—	—
Glycerine	lb.	—	.19 – .21
Iodine, resublimed	lb.	—	4.50 –
Iron oxide, red	lb.	—	.03 – .20
Iron sulphate, (copperas)	cwt.	1.00 –	1.20 – 1.50
Lead acetate, normal	lb.	—	.12½ – .14½
Lead arsenate (paste)	lb.	—	.13 – .17
Lead nitrate, crystals	lb.	—	.85 – .86½
Litharge	lb.	—	.09½ – .10½
Lithium Carbonate	lb.	—	1.50 –
Magnesium carbonate, technical	lb.	—	.13 – .14½
Magnesium sulphate, U. S. P.	100 lb.	2.00 – 2.63	2.75 – 3.00
Magnesium sulphate, commercial	100 lb.	1.75 –	2.00 – 2.50
Nickel salt, double	lb.	.14 –	.15 –
Nickel salt, single	lb.	.12 –	.15 – .16
Phosgene (see carbonyl chloride)		—	—
Phosphorus, red	lb.	—	.60 – .70
Phosphorus, yellow	lb	—	.35 – .37
Potassium bichromate	lb.	.28 – .30	—
Potassium bitartrate (cream of Tartar)	lb.	—	.55 – .60
Potassium bromide, granular	lb.	—	— .60
Potassium carbonate, U. S. P.	lb.	.60 –	.65 – .70
Potassium carbonate, crude	lb.	.19 –	.21 –
Potassium chlorate, crystals	lb.	.20 – .24	.25 – .30
Potassium cyanide, 98-99 per cent.	lb.	nominal	
Potassium hydroxide (caustic potash)	lb.	.30 – .32	.35 – .40
Potassium iodide	lb.	—	3.35 – 3.60
Potassium nitrate	lb.	.19 –	.1 –
Potassium permanganate	lb.	—	.5 – .6
Potassium prussiate, red	lb.	—	1.5 – 1.55
Potassium prussiate, yellow	lb.	—	.45 – .55
Potassium sulphate	ton	225.00 –	—
Rochelle salts (see sodium potas, tartrate)		—	—
Salammoniac (see ammonium chloride)		—	—
Sal soda (see sodium carbonate)		—	—
Salt cake (sodium sulphate)	ton	17.00 – 21.00	—
Silver cyanide	oz.	—	1.19 –
Silver nitrate	oz.	—	.69½ – .70½
Soda ash, light	100 lb.	1.90 –	2.00 –
Soda ash, dense	100 lb.	2.25 –	2.50 – 2.75
Sodium acetate	lb.	.05½ – .06½	.07 – .08
Sodium bicarbonate	100 lb.	2.35 –	2.75 – 3.00
Sodium bichromate	lb.	.12½ –	.12½ – .13
Sodium bisulphate (nitre cake)	ton	3.00 – 8.00	10.00 –
Sodium bisulphite	cwt.	1.80 – 1.90	2.00 – 2.10
Sodium borate (borax)	lb.	.07½ –	.08 – .08½
Sodium carbonate (sal soda)	100 lb.	1.35 – 1.50	1.50 – 1.75
Sodium chlorate	lb.	.15 –	.16 – .18½
Sodium cyanide	lb.	.30 –	.31 – .34
Sodium fluoride	lb.	.14 –	.15 – .16
Sodium hydroxide (caustic soda)	100 lb.	3.30 – 3.40	3.45 – 3.50
Sodium molybdate	lb.	2.50 –	3.25 –
Sodium nitrate	100 lb.	3.00 – 3.25	3.75 – 4.00
Sodium nitrite	lb.	.14 – .17	— .18
Sodium peroxide, powdered	lb.	—	.30 – .32
Sodium phosphate, dibasic	lb.	.03½ – .04	.04½ – .05
Sodium potassium tartrate (Rochelle salts)	lb.	—	.43 – .45½
Sodium prussiate, yellow	lb.	.21 –	.22 –
Sodium silicate, solution (40 deg.)	lb.	.01½ – .02	.02 – .02½
Sodium silicate, solution (60 deg.)	lb.	.02½ – .03	.03½ – .04½
Sodium sulphate, crystals (Glauber's salts)	cwt.	1.15 – 1.25	1.50 – 2.00
Sodium sulphide, crystal, 60-62 per cent. (conc)	lb.	—	.05 – .06
Sodium sulphite, crystals	lb.	.03½ –	.04 – .06
Strontium nitrate, crystals	lb.	.25 –	.28 –
Sulphur chloride	lb.	.05½ –	.06 –
Sulphur, crude	ton	22.00 –	—
Sulphur dioxide, liquid, cylinders	lb.	—	.10 – .12
Sulphur (sublimed), flour	100 lb.	3.10 –	3.40 – 3.65
Sulphur, roll (brimstone)	100 lb.	2.95 –	3.15 – 3.40
Tin bichloride (stannous)	lb.	.44 –	.46 – .50
Tin oxide	lb.	—	.60 –
Zinc carbonate, precipitate	lb.	—	.20 –
Zinc chloride, gran.	lb.	.12½ –	.13½ – .14
Zinc cyanide	lb.	.49 –	.50 –
Zinc dust	lb.	.09 – .11	.11 – .14
Zinc oxide, dry American	lb.	—	.09½ – .09½
Zinc sulphate	lb.	.03½ – .03½	.04 – .04½

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude	lb.	$1.00 —	$1.10
Alpha naphthol, refined	lb.	1.40 —	1.50
Alpha naphthylamine	lb.	.32 —	.50
Aniline oil, drums extra	lb.	.32 —	.33
Aniline salts	lb.	.32 —	.35
Anthracine, 80% in drums (100 lb.)	lb.	.90 —	1.00
Benzaldehyde (f.f.c.)	lb.	1.00 —	1.15
Benzidine, base	lb.	1.00 —	1.25
Benzidine, sulphate	lb.	.90 —	1.15
Benzoic acid, U. S. P.	lb.	.90 —	1.10
Benzoate of soda, U. S. P.	lb.	.85 —	1.10
Benzol, pure, water-white, in drums (100 lb.)	gal.	.32 —	....
Benzol, 90%, in drums (100 lb.)	gal.	.24 —	.28
Benzyl chloride, 95-97%, refined	lb.	.35 —	.40
Benzyl chloride, tech.	lb.	.25 —	.35
Beta naphthol benzoate	lb.	3.75 —	4.50
Beta naphthol, sublimed	lb.	.75 —	.80
Beta naphthol, tech.	lb.	.45 —	.55
Beta naphthylamine, sublimed	lb.	2.25 —	2.35
Cresol, U. S. P., in drums (100 lb.)	lb.	.18 —	....
Ortho-cresol, in drums (100 lb.)	lb.	.23 —	.25
Cresylic acid, 97-99%, straw color, in drums	gal.	.85 —	.90
Cresylic acid, 95-97%, dark, in drums	gal.	.80 —	.85
Cresylic acid, 50%, first quality, drums	gal.	.60 —	....
Dichlorbenzol	lb.	.07 —	.10
Diethylaniline	lb.	1.40 —	2.25
Dimethylaniline	lb.	.55 —	.60
Dinitrobenzol	lb.	.26 —	.37
Dinitroclorbenzol	lb.	.25 —	.30
Dinitronaphthaline	lb.	.45 —	.55
Dinitrophenol	lb.	.33 —	.36
Dinitrotoluol	lb.	.38 —	.45
Dip oil, 25%, tar acids, car lots, in drums	gal.	.38 —	.65
Diphenylamine	lb.	.58 —	.75
H-acid	lb.	1.60 —	1.75
Metaphenylenediamine	lb.	1.15 —	1.80
Monochlorbenzol	lb.	.12 —	.15
Monoethylaniline	lb.	1.50 —	1.75
Naphthaline crushed, in bbls. (250 lb.)	lb.	.06 —	.08
Naphthaline, flake	lb.	.06½ —	.07½
Naphthaline, balls	lb.	.08½ —	.10
Naphthionic acid, crude	lb.	.75 —	1.25
Nitrobenzol	lb.	.14 —	.19
Nitro-naphthaline	lb.	.35 —	.45
Nitro-toluol	lb.	.27 —	.20
Ortho-amidophenol	lb.	3.00 —	4.25
Ortho-dichlor-benzol	lb.	.15 —	.20
Ortho-nitro-phenol	lb.	.90 —	1.25
Ortho-nitro-toluol	lb.	.25 —	.40
Ortho-toluidine	lb.	.25 —	.45
Para-amidophenol, base	lb.	2.50 —	3.50
Para-amidophenol, HCl	lb.	2.50 —	3.25
Para-dichlor-benzol	lb.	.15 —	.18
Paranitraniline	lb.	.95 —	1.10
Para-nitro-toluol	lb.	1.35 —	1.50
Paraphenylenediamine	lb.	2.50 —	4.00
Paratoluidine	lb.	1.50 —	2.50
Phthalic anhydride	lb.	1.50 —	2.15
Phenol, U. S. P., drums (dest.), (240 lb.)	lb.	.16 —	.17
Pyridin	gal.	2.50 —	....
Resorcin, technical	lb.	3.50 —	3.75
Resorcin, pure	lb.	6.50 —	6.75
Salicylic acid, tech., in bbls (110 lb.)	lb.	.37 —	.45
Salicylic acid, U. S. P.	lb.	.45 —	.50
Salol	lb.	.90 —	.95
Solvent naphtha, water-white, in drums, 100 gal	gal.	.20 —	.27
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.18 —	.24
Sulphanilic acid, crude	lb.	.25 —	.3[illegible]

Tolidine	lb.	$1.70	—	$2.50
Toluidine, mixed	lb.	.45	—	.55
Toluol, in tank cars	gal.	.26	—	....
Toluol, in drums	gal.	.27	—	.30
Xylidine, drums, 100 gal.	lb.	.44	—	.50
Xylol, pure, in drums	gal.	.37	—	.45
Xylol, pure, in tank cars	gal.	.35	—	....
Xylol, commercial, in drums, 100 gal.	gal.	.23	—	.27
Xylol, commercial, in tank cars	gal.	.22	—	....

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow	lb.	$0.42	—	$0.44
Beeswax, refined, yellow	lb.	.46	—	.88
Beeswax, white pure	lb.	.64	—	.66
Carnauba, No. 1	lb.	.85	—	.88
Carnauba, No. 2, regular	lb.	.67	—	.80
Carnauba, No. 3, North Country	lb.	.48	—	.50
Japan	lb.	.18	—	.20
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.06	—	....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.06	—	....
Paraffine waxes, refined, 118-120 m.p.	lb.	.07	—	.08
Paraffine waxes, refined, 128-130 m.p.	lb.	.09	—	....
Paraffine waxes, refined, 133-135 m.p.	lb.	.10½	—	.11
Paraffine waxes, refined, 135-137 m.p.	lb.	.12	—	.13½
Stearic acid, single pressed	lb.	.26	—	.28
Stearic acid, double pressed	lb.	.27	—	.29
Stearic acid, triple pressed	lb.	.31	—	.33

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr., 0.930-0.940	gal.	$1.10
Pine oil, pure, dest. dist.	gal.	.96
Pine tar oil, ref., sp. gr. 1.025-1.035	gal.	.45
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.34
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.	.65
Pine tar, ref., thin, sp. gr., 1.080-1.960	gal.	.38
Turpentine, crude, sp. gr., 0.900-0.970	gal.	.85
Hardwood oil, f.o.b. Mich., sp. gr., 0.960-0.990	gal.	.30
Pinewood creosote, ref.	gal.	.48

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.	280 lb.	$16.25	—	$17.50
Rosin E-I	280 lb.	17.00	—	19.25
Rosin K-N	280 lb.	20.50	—	23.00
Rosin W. G.-W. W.	280 lb.	24.00	—	24.25
Wood rosin, bbl.	280 lb.	16.00	—	17.00
Spirits of turpentine	gal.	1.70	—	....
Wood turpentine, steam dist.	gal.	1.50	—	....
Wood turpentine, dest. dist.	gal.	1.48	—	....
Pine tar pitch, bbl.	200 lb.	8.25	—	8.50
Tar, kiln burned, bbl. (500 lb.)	bbl.	13.50	—	14.25
Retort tar, bbl.	280 lb.	14.50	—	14.90
Rosin oil, first run	gal.	.86	—	.91
Rosin oil, second run	gal.	.88	—	.93
Rosin oil, third run	gal.	.95	—	1.07
Rosin oil, fourth run	gal.	1.05	—	1.10

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.33½		
70-72 deg., steel bbls. (85 lb.)	gal.	.31½		
68-70 deg., steel bbls. (85 lb.)	gal.	.30½		
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.23½		

Crude Rubber

Para—Upriver fine	lb.	$0.52	—	$0.52½
Upriver coarse	lb.	.31	—	.32½
Upriver caucho ball	lb.	.32	—	.32½
Plantation—First latex crepe	lb.	.49½	—	.50
Ribbed smoked sheets	lb.	.48½	—	.49
Brown crepe, thin, clean	lb.	.43½	—	.44
Amber crepe No. 1	lb.	.47	—	.48

Oils

VEGETABLE

Unless otherwise noted, the following prices are f.o.b., New York.

Castor oil, No. 3, in bbls.	lb.	$0.18	—	$0.19
Castor oil, AA, in bbls.	lb.	.21	—	.22
China wood oil, in bbls.	lb.	.22	—	.23
Cocoanut oil, Ceylon grade, in bbls.	lb.	.17½	—	.18
Cocoanut oil, Cochin grade, in bbls.	lb.	.19	—	.20
Corn oil, crude, in bbls.	lb.	.17	—	.23
Cottonseed oil, crude (f.o.b. mill)	lb.	.17½	—	.19
Cottonseed oil, summer yellow	lb.	.22	—	.24
Cottonseed oil, winter yellow	lb.	.22	—	.25
Linseed oil, raw, car lots	gal.	1.75	—	....
Linseed oil, raw, tank cars	gal.	1.65	—	1.70
Linseed oil, boiled, car lots	gal.	1.70	—	1.75
Olive oil, commercial	gal.	2.40	—	2.50
Palm, Lagos	lb.	.17	—	.17½
Palm, bright red	lb.	.16½	—	.17½
Palm, Niger	lb.	.16	—	.17
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.20	—	.21
Peanut oil, refined, in bbls.	lb.	.23	—	.25
Rapeseed oil, refined in bbls.	gal.	1.50	—	1.60
Rapeseed oil, blown, in bbls.	gal.	1.57	—	1.70
Soya bean oil (Manchurian), in bbls., N. Y.	lb.	.17½	—	.18
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.14½	—	.15

FISH

Winter pressed Menhaden	gal.	$1.28	—	
Yellow bleached Menhaden	gal.	1.30	—	$1.31
White bleached Menhaden	gal.	1.32	—	....
Blown Menhaden	gal.	1.34	—	1.38

Miscellaneous Materials

All Prices f.o.b., N. Y.

Barytes, domestic, white, floated	ton	$25.00	—	$36.00
Barytes, off color	ton	20.00	—	25.00
Blanc fixe, dry	lb.	.03½	—	.04½
Blanc fixe, pulp	ton	35.00	—	47.50
Casein	lb.	.16	—	.18
Chalk, English, extra light	lb.	.05	—	.07
Chalk, English, light	lb.	.04½	—	.06
Chalk, English, dense	lb.	$ .04	—	$ .05
China clay (Kaolin), imported, lump	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered	ton	30.00	—	60.00
China clay (Kaolin), domestic, lump	ton	10.00	—	20.00
China clay (Kaolin), domestic, powdered	ton	25.00	—	40.00
Feldspar	ton	12.00	—	16.00
Fluorspar, acid grade, lump, f.o.b. mines	net ton	30.00	—	$35.00
Fluorspar, acid grade, ground, f.o.b. mines	net ton	35.00	—	45.00
Fuller's earth, domestic, powdered	ton	30.00	—	40.00
Fuller's earth, imported, powdered	ton	....	—	....
Pumice stone, imported	lb.	.03	—	.06
Pumice stone, domestic	lb.	.02½	—	....
Shellac, TN	lb.	1.00	—	....
Shellac, D. C.	lb.	....	—	....
Shellac, V. S. O.	lb.	....	—	....
Shellac, Diamond I.	lb.	....	—	....
Shellac, orange, fine	lb.	1.05	—	....
Shellac, orange, superfine	lb.	1.10	—	1.30
Shellac, A.C. garnet	lb.	1.00	—	....
Shellac, bleached, bone dry	lb.	1.25	—	....
Shellac, bleached, fresh ground	lb.	1.20	—	....
Soapstone	ton	15.00	—	25.00
Talc, domestic	ton	16.00	—	60.00
Talc, imported	ton	55.00	—	60.00

Refractories

Following prices are f.o.b. works:

Chrome brick	net ton	80-90 at Chester, Penn.
Chrome cement	net ton	45-50 at Chester, Penn.
Clay brick, 1st quality fireclay	net ton	35-45 at Clearfield, Penn.
Clay brick, 2nd quality	net ton	30-35 at Clearfield, Penn.
Magnesite, dead burned	net ton	50-55 at Chester, Penn.
Magnesite brick, 9 x 4½ x 2½ in.	net ton	80-90 at Chester, Penn.
Silica brick	net ton	41-45 at Mt. Union, Penn.

Ferro-alloys

All prices f.o.b. works.

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00	—	$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon	lb.	.25	—	.40
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon	lb.	.70	—	....
Ferro-manganese, 70-80% Mn	gross ton	105.00	—	115.00
Spiegeleisen, 16-20% Mn	gross ton	35.00	—	36.00
Ferro-molybdenum, per lb. of Mo	lb.	2.50	—	3.00
Ferro-silicon, 50%	gross ton	85.00	—	95.00
Ferro-silicon, 75%	gross ton	150.00	—	175.00
Ferro-silicon, 10-15%	gross ton	45.00	—	60.00
Ferro-tungsten, 70-80%, per lb. of contained W.	lb.	1.25	—	1.40
Ferro-uranium, 35-50%, of U	lb.	7.00	—	....
Ferro-vanadium, 30-40% per lb. of contained V.	lb.	5.50	—	7.00

Ores and Semi-finished Products

Chrome ore, 35-40%, Cr_2O_3	unit	$0.60	—	$0.80
Chrome ore, 48% and over	unit	.90	—	1.00
Coke, foundry, f.o.b. ovens	net ton	5.50	—	6.00
Coke, furnace, f.o.b. ovens	net ton	4.00	—	5.00
Petroleum coke, refinery, Atlantic seaboard	net ton	12.00	—	12.50
Fluorspar, gravel, f.o.b. mines	net ton	20.00	—	25.00
Manganese ore, 45% Mn and over	unit	.50	—	.75
Manganese ore, chemical (MnO_2)	gross ton	60.00	—	70.00
Molybdenite, 85% MoS_2, per lb. of MoS_2	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO_3 and over, per unit of WO_3	unit	9.00	—	15.00
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3	unit	7.50	—	10.00
Uranium oxide, 96%	lb.	....	—	....
Vanadium pentoxide, 99%	lb.	6.00	—	....
Pyrites, foreign, lump	unit	.13	—	....
Pyrites, foreign, fine	unit	.13	—	....
Pyrites, domestic, fine	unit	.14	—	.17½
Ilmenite, 52% TiO_2, f.o.b. N. Y.	net ton	40.00	—	....
Rutile, 95% TiO_2, f.o.b. N. Y.	net ton	200.00	—	....
Carnotite, minimum 2% U_3O_8, per lb. of U_3O_8	lb.	2.75	—	3.00
Zircon, washed, iron free, f.o.b. N. Y.	net ton	135.00	—	....
Monazite, per unit of ThO_2, f.o.b. N. Y.	unit	42.00	—	....

Plant Materials and Supplies

In carload lots, New York, unless otherwise stated.

BUILDING MATERIALS

Portland cement, at dock, without bags	bbl.	$2.30
Lump lime, common, including container	300 bbl.	2.65
Common brick, at dock	M.	15.00
Yellow pine, 3x4 to 8x8, 20 ft. and under	M.	48.00
Yellow pine, 3x4 to 8x8, 20 ft. and under at Chicago	M.	55.00
Yellow pine, 3x4 to 8x8, 20 ft. and under at St. Louis	M.	43.00
Roofings, tar felt (14 lb. per 100 sq.ft.)	ton	60.00-70.00
Roofings, tar pitch (in 400-lb. bbl.) carlots	ton	21.00
Roofings, asphalt pitch carlots	ton	34.00
Roofings, asphalt felt carlots	ton	63.00
Roofings, slate-surfaced, per roll of 108 sq.ft. carlots		2.25
Roofings, slate-finished shingles, 100 sq.ft. carlots		6.00
Linseed oil, raw in barrels	gal.	1.80
Linseed oil, 5 gal. cans	gal.	1.93
Red lead, dry, 100 lb. keg	lb.	.13
Red lead, in oil, 100 lb. keg	lb.	.14½
Red lead, dry, 5 lb. cans	lb.	.15
Red lead, in oil, 5 lb. cans	lb.	.16½
White lead, dry and in oil, 100 lb. keg	lb.	.13
White lead, dry and in oil, 25 and 50 lb. kegs	lb.	.13½
White lead, dry and in oil, 5 lb. cans	lb.	.15

STRUCTURAL STEEL, MILL, PITTSBURGH

Beams and channels, 3 to 15-in.	100 lb.	$2.45
Angles, 3 to 6-in., ¼-in. thick	100 lb.	2.45
Tees, 3-in. and larger	100 lb.	2.45
Plates	100 lb.	2.66
Rivets, structural, ½-in. and larger	100 lb.	4.20
Rivets, conehead for boilers, ½-in. and larger	100 lb.	4.30
Sheets, No. 28 black	100 lb.	4.35
Sheets, No. 10 blue annealed	100 lb.	3.55
Sheets, No. 28 galvanized	100 lb.	5.70

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. fo 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.